WESTERN GAS

April 1931

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503

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NEXT MONTH

ANNUAL

NATURAL GAS EDITION of WESTERN GAS

FEATURE CONTENTS

Again this year the Natural Gas Edition will include maps and valuable statistical material—compiled by the editors, and NOT available elsewhere. Among the special features to be presented in this issue are the following:

PIPE LINE REVIEW

—detailing 1930 gas transmission construction and 1931 projects, company names, location of lines, lengths, sizes and costs.

PIPE LINE MAP

—charting all gas transmission lines in the 22 western states and western Canada, and indicating routes of proposed lines. Size 40 by 40 inches.

NEW GAS TOWNS

—listing communities where gas service was begun in 1930. Also listing towns where franchises have been granted, service to commence in 1931.

BUTANE PLANTS

—listing names of towns, number of meters, type of service.

APPLIANCE REVIEW

—presenting 1929-1930 sales of individual appliances by companies; also sales quotas for 1931.

ORDER NOW

Remit 35 cents per copy—which includes cost of postage and mailing.

LAST ADVERTISING FORMS WILL CLOSE ON APRIL 20TH

WESTERN GAS

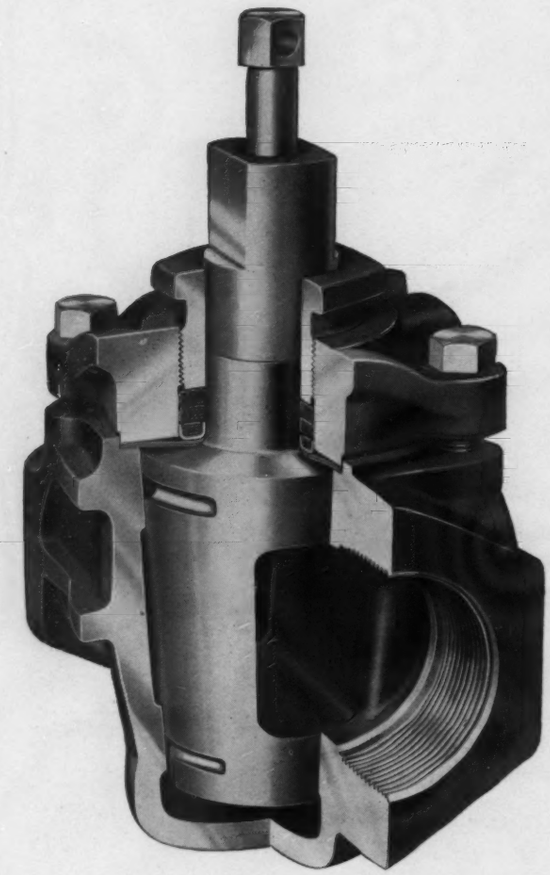
124 West Fourth Street Los Angeles

APR 9 1931

PERIODICAL

A MONTHLY JOURNAL DEVOTED TO THE WESTERN GAS & APPLIANCE INDUSTRIES

Why Nordstrom builds the PLUG COCK type of valve



Nordstrom Valve with patented "Sealdport" method of pressure lubrication. "Merco" lubricants should always be used.

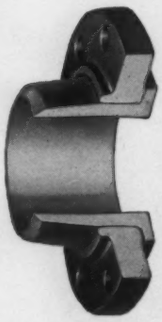
A plug cock by its nature provides the most effective form of valve for combating corrosion or erosion when the valve is used as a stop in a line. This is because when the valve is opened and the line content is flowing through the valve, none of the vital parts are exposed to disintegrating forces. No machined surfaces are being eroded or corroded. Even in the closed position, the portion of the plug surface which is in contact with the line content, is not the portion required to effect a shut-off with the interior ground surface of the body. The plug cock is also the simplest, most rugged type of valve.

Nordstrom has added to these advantages of the plug cock by embodying a method of pressure lubrication. By its use, plug cocks as large as 30″ in size are perfectly practical and easily operated. Also, special "Merco" Lubricants introduced under pressure, offer the most effective method of sealing the valve against leakage long after an unlubricated valve might develop leaks.

This combination of the patented Nordstrom method of pressure lubrication and the natural advantages of the plug cock type of valve, offer the most satisfactory solution to valve problems.

ASK FOR LATEST CATALOG

MERCO



Also
"Merco" Flanges

A new type of flange joint for use with welded pipe lines requiring insertion of valves and fittings for the taking off of outlets. Extremely flexible. Size from 1½″ to 10″.

MERCO NORDSTROM VALVE COMPANY
SUBSIDIARY OF THE MERRILL COMPANY . . ENGINEERS

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Saginaw - Arthur C. Beckert, 112 Durand St.
Salt Lake City - National Equipment Co., 101 West 2nd South St.
Tulsa - B.V. Emery & Company, 216 E. Brady Street

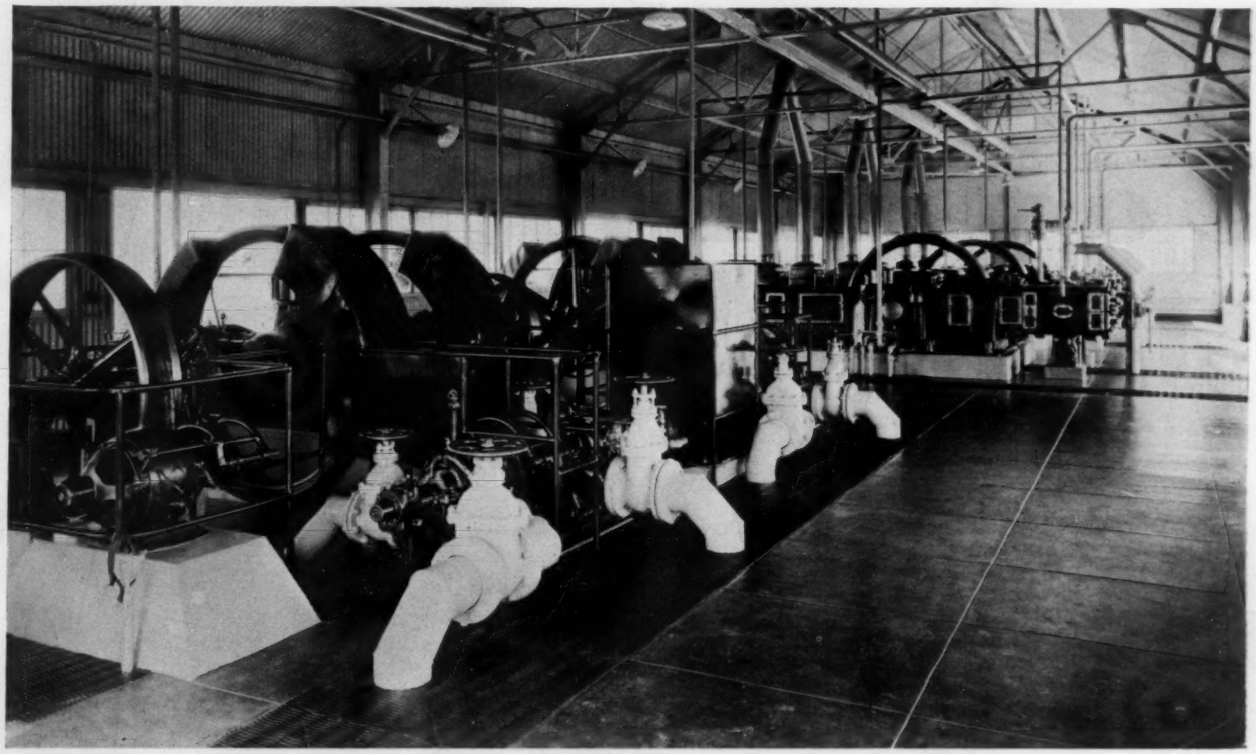
Factory - Oakland, Calif.

Canada - Peacock Bros., Ltd., Montreal, Toronto, Winnipeg, Vancouver. (Also Sydney, N.S.)
England - Audley Engineering Co., Ltd., Newport, Shropshire.
Buenos Aires, Argentine, - General Electric, Soc. Anon., Victoria 618 Esq. Peru.

NORDSTROM VALVES

THE PERFECT APPLICATION OF A PRINCIPLE

ANOTHER COMPRESSOR STATION by FLUOR



Fluor

Cooling Towers
Absorption Plants
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Boiler Plants
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Consult Fluor Engineers Regarding Your Requirements

IT IS good to know that a name can carry such assurance of efficient, dependable performance as Fluor builds into every Fluor installation. More than forty years of specialized experience in this particular field of structural engineering accounts for our ability to give you the most modern, efficient, economical and reliable plant for a given sum.

The name Fluor is a symbol of integrity in equipment, construction and installation—your guarantee of the best in value and performance.

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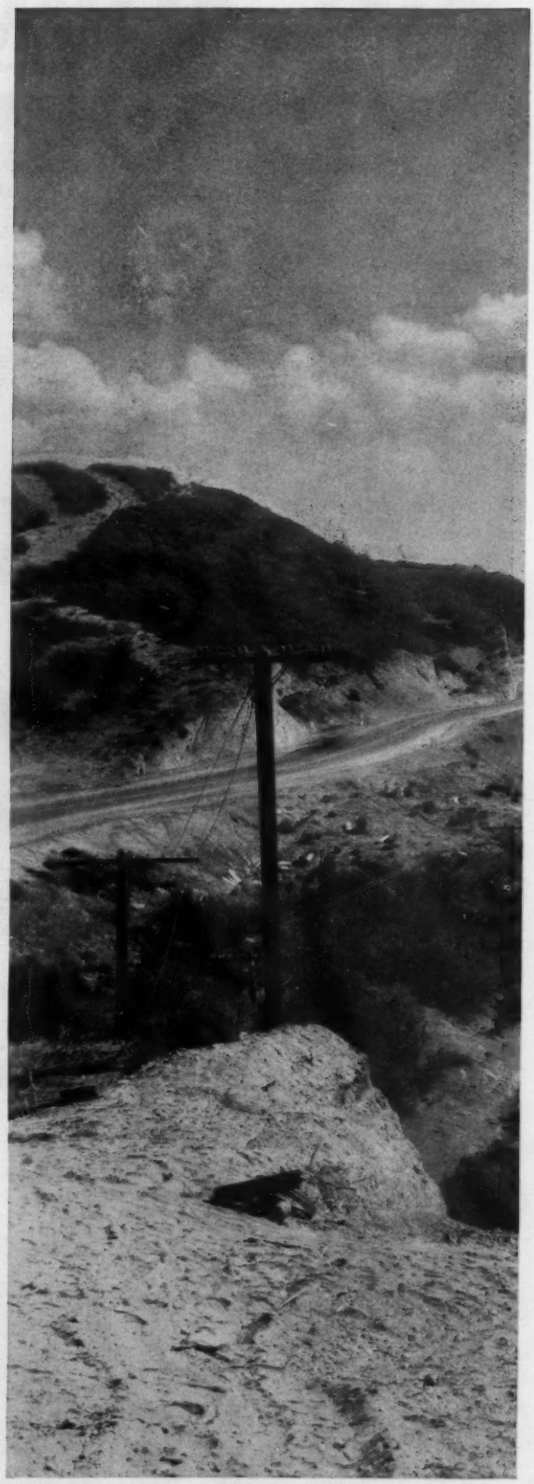
April, 1931, Volume VII, Number 4, Western Gas is published by Western Business Papers, Inc., at 124 West Fourth Street, Los Angeles, California. Subscription price (in advance) 20 cents the copy; $2.00 per year; 3 years $5.00; $3.00 per year foreign. Entered as second class matter June 1, 1925, at the postoffice at Los Angeles, under the Act of March 3, 1879.

FORTY FOOT

In Rough Country Too . . .



It took 17¾ miles of pipe to advance 13 miles over the roughest, toughest part of the Southern California Line. The pipe was SMITHWelded 26-inch Gas Line Pipe — 40-foot lengths. Despite the many bends and joints cutting up the line, the 13-mile stretch was completed with an average of 1 weld in every 31 feet —proving, rather conclusively, that long lengths pay in rough country, too . . .

A new book, "The New Way of Designing and Building Gas Lines with SMITHWelded Pipe," provides for the benefit of the industry a scientific method, simple in application, to determine the factors effecting a minimum cost of pipe lines. A copy will be sent upon request to anyone interested.

A. O. SMITH CORPORATION

General Offices: Milwaukee, Wisconsin

OIL AND GAS FIELD PRODUCTS DIVISION

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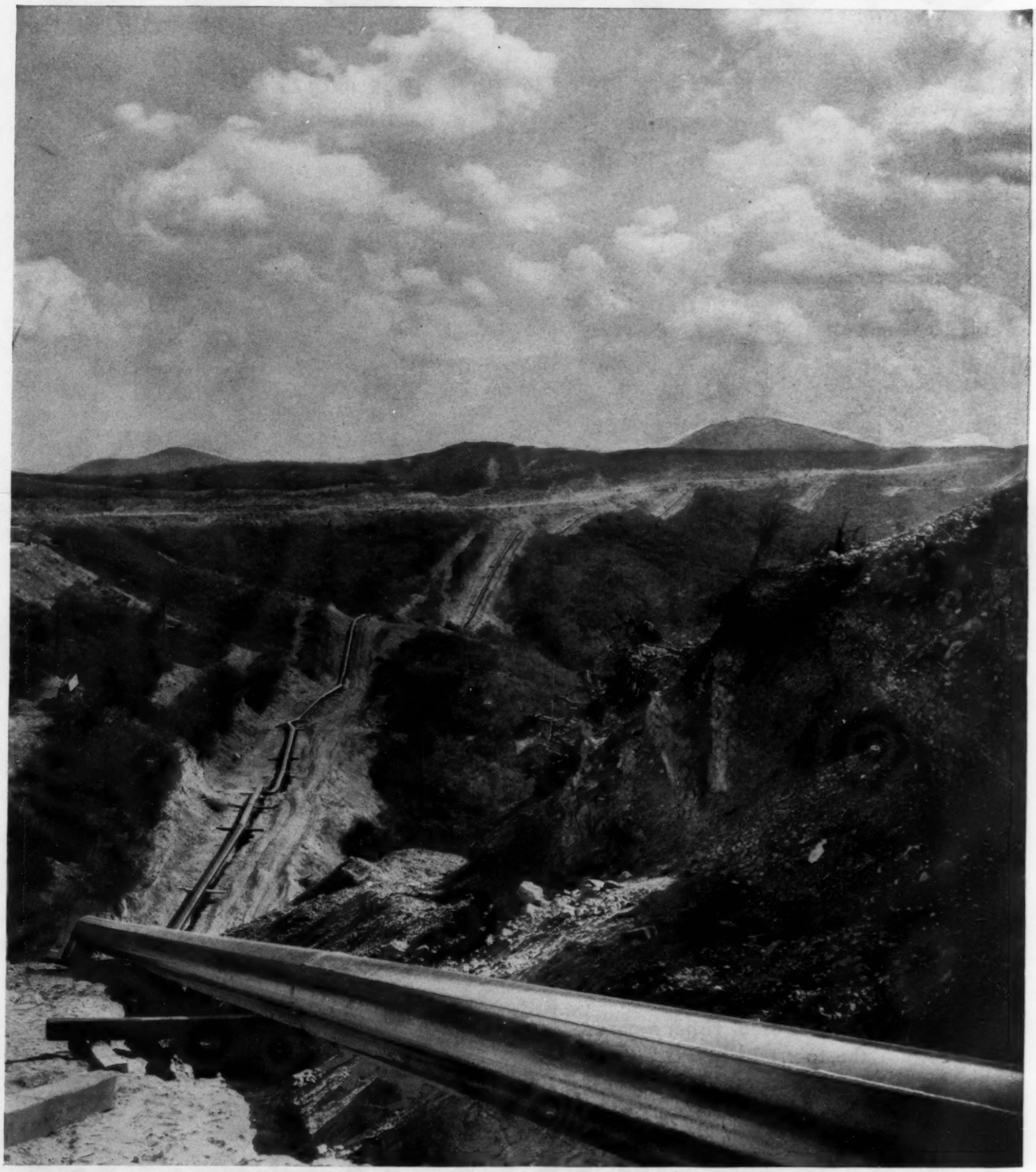
SMITH WELDED

PIPE LINE AT THE

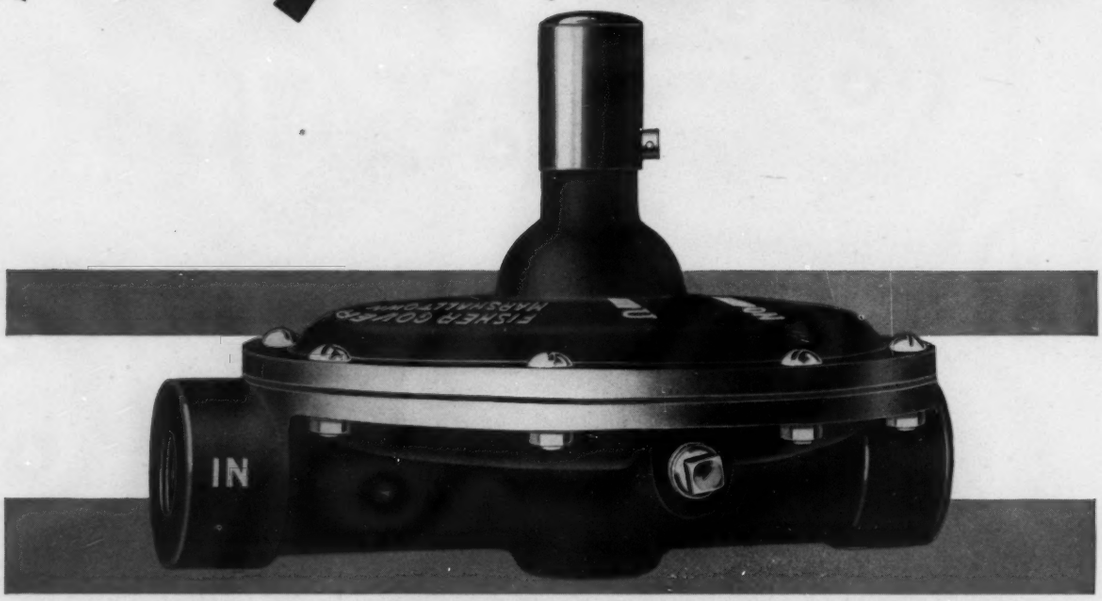
LENGTHS PAY



GAS LINE PIPE

LOWEST COST PER MILE

8,895,000



That is the number of times this Fisher House Service Regulator was opened and closed during a test under actual working conditions to determine whether the diaphragm and seat materials were those best suited to the particular service for which the regulator was to be used. The initial pressure was 150 pounds while the reduced pressure was 10 inches of water. The test required approximately 1100 hours, and at the end of that time the regulator was working perfectly and showed no signs of wear.

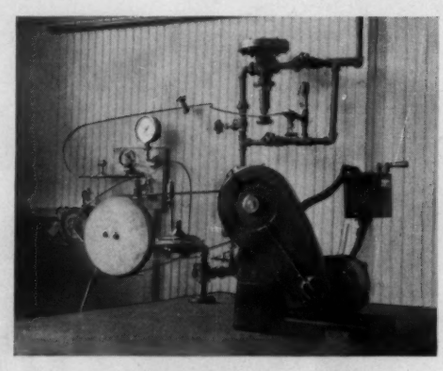
This instance is typical of the care that is exercised to make certain that every type of Fisher House Service Regulator is exactly suited to the operating conditions for which it will be used. Fisher realizes the fact that a "stock regulator" cannot give the best results with the different kinds of gas now in use . . . the regulator that is correct for manufactured gas in not the best for natural gas.

As a consequence, Fisher "Custom Built" House Service Regulators have established an enviable reputation for close and dependable regulation, trouble-free operation and long life. Facilities are adequate for prompt shipment.

Ask for Circular No. 805 which gives the details.

FISHER GOVERNOR CO.

2400 FISHER BLDG.
MARSHALLTOWN
IOWA



Photograph of the equipment used for making this test in the Fisher Experimental Laboratory

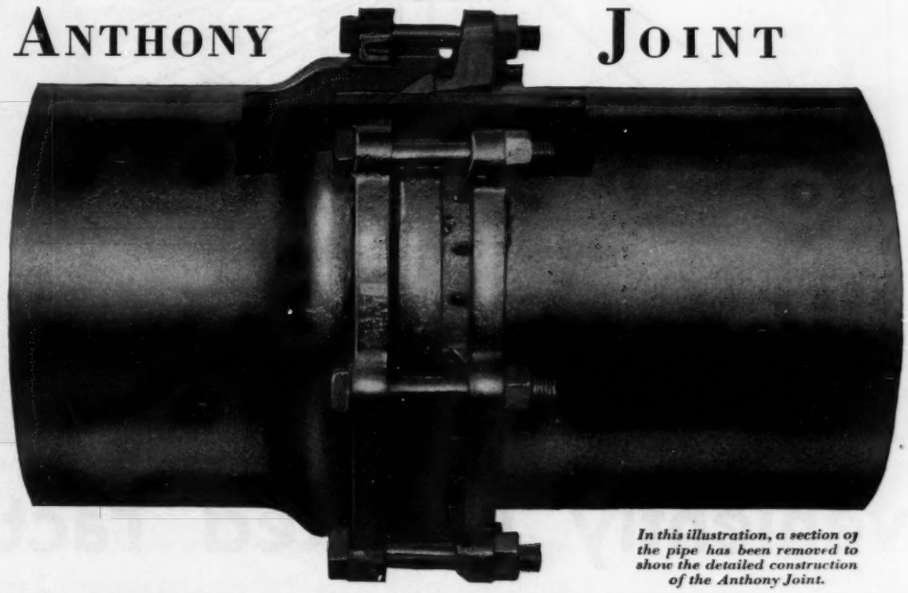
FOR FISHER FIFTY YEARS

THE MARK OF
SCIENTIFIC FLUID CONTROL

For FAST *assembly . . .*

the

ANTHONY JOINT



In this illustration, a section of the pipe has been removed to show the detailed construction of the Anthony Joint.

only 3 easy operations

No longer do you have to bother with troublesome and exacting details to assure the tightness of a joint under high gas pressures. The Anthony Joint eliminates unnecessary delay, thus bringing about an appreciable saving in installation costs.

With the Anthony Joint, you merely put *one* gasket in place and bolt two rings together. Just three easy operations and there's a joint which will withstand high gas pressures 24 hours out of every day—without the sign of a leak.

The Anthony Joint allows for a surprising amount of deflection too. By using this joint, you can lay an absolutely leak-proof line in steep or rolling country.

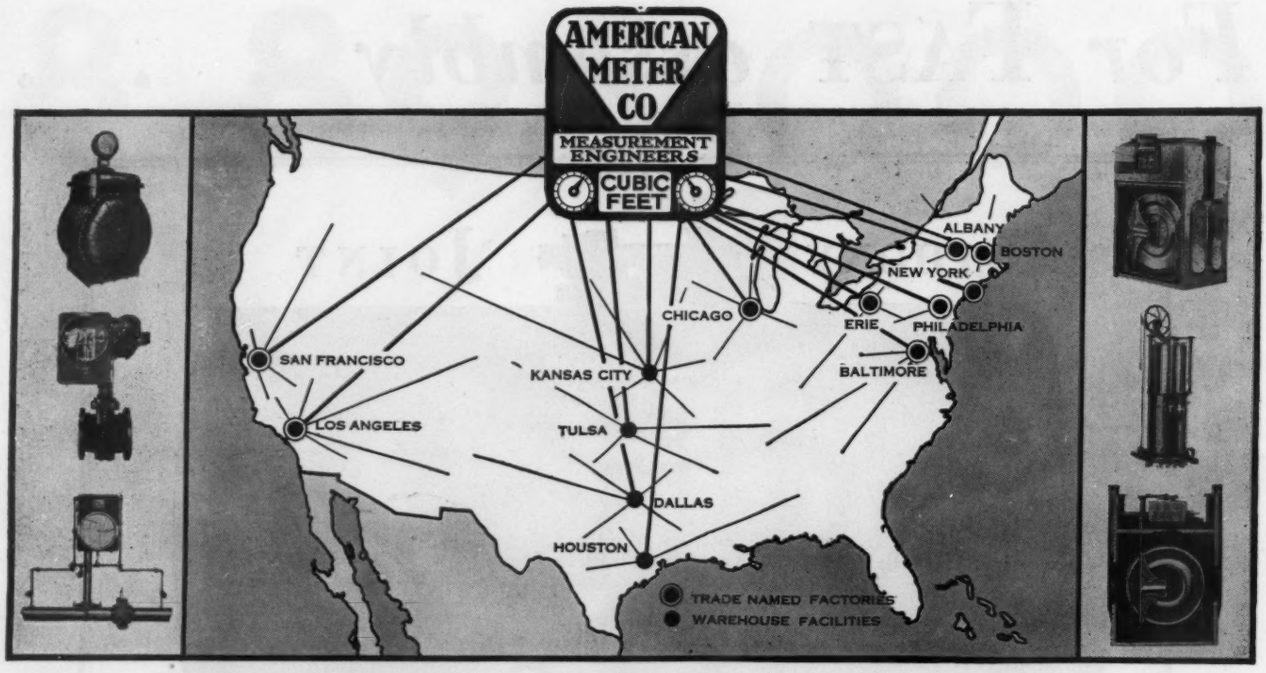
The New Anthony Joint is offered in either deLavaud centrifugally cast pipe or in pit cast pipe and fittings. All rings, bolts and gaskets are interchangeable.

Of special interest is the fact that Anthony Joint bends, tees and other fittings can also be used with plain end pipe. These Anthony Joint fittings enable the contractor to make sure of the tightness of the important terminal points of his line. Ask us for complete information regarding the many advantages which this new joint offers.

United States Pipe and Foundry Co., Burlington, N.J.

Our pipe bears the "Q-Check" trademark of The Cast Iron Pipe Research Association

Sales Offices:
New York, Philadelphia, Pittsburgh, Cleveland, Buffalo, Chicago, Dallas, Birmingham, Kansas City, Minneapolis, Seattle, San Francisco, Los Angeles



Conveniently Located Factories

American Meter Company
New York
Established 1836

American Meter Company
Chicago
Established 1896

John J. Griffin & Company
Philadelphia
Established 1859

Heime & McIlhenny
Philadelphia
Established 1848

supported by nation-wide experience and facilities

Ninety-four years ago — shortly after the first gas plant was founded in this country — American Meter Company opened its first factory. Today American Meter Company supplies the gas industry from ten trade-named factories strategically located from coast to coast.

Each factory is an integral part of a comprehensive manufacturing organization, supervised by trained engineers. Each American Meter is made to the highest standards of accurate measurement and economical service.

Old Types Improved
New Types Developed

A pioneer in the manufacture of gas meters, American Meter Company is still pioneering in the development of improved gas measuring and testing apparatus.

With increasing experiment and intensive research, the engineers of American Meter Company are constantly improving established meters, and developing new equipment to meet new requirements.

Many Branches Provide Intensive Local Service

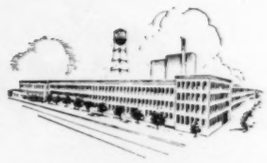
The geographical distribution of American Meter Company branches assures quick delivery and prompt engineering and shop service. It also permits an intensive knowledge of local conditions and their specific requirements.

Whenever you have a meter problem call in an American Meter Company representative. He will gladly bring to its solution a personal interest, supported by the experience of extensive laboratory experiment and of gas measurement practically applied in every part of the country.

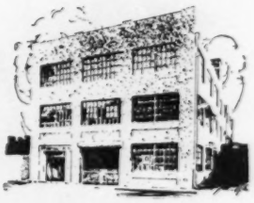
"Gas Measurement Engineering," a periodic publication of American Meter Company will be of interest to you—also the complete index to this Company's other printed information. We will be pleased to place your name on our mailing list.

D. McDonald & Company
Albany
Established 1855

Maryland Meter Works
Baltimore
Established 1866

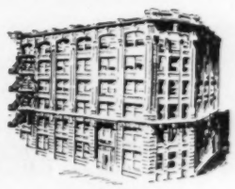


Metric Metal Works
Erie, Pa.
Established 1889



Pacific Meter Works
Los Angeles
Established 1901

Pacific Meter Works
San Francisco
Established 1901



Nathaniel Tufts Meter Works
Boston
Established 1860

AMERICAN METER CO
MEASUREMENT ENGINEERS
CUBIC FEET

AMERICAN METER COMPANY

Incorporated

General Offices: 105 West 40th Street, New York, New York . . . . Established 1836

THE WORLD'S LARGEST MANUFACTURERS OF GAS METERS AND ALLIED APPARATUS

SALES ALBANY · BALTIMORE · BOSTON · CHICAGO · DALLAS · DENVER · ERIE · KANSAS CITY
SERVICE LOS ANGELES · NEW YORK · PHILADELPHIA · PITTSBURGH · SAN FRANCISCO · TULSA

1 Full length crawlers; carbo-manganese shoes and sprockets; automatic spring take-up keeps the crawler tread tight.

2 Vertical Digging Boom, making very short overall length, digs its way in, reduces to a minimum lost ditch at house and walks.

3 Milling action digging—goes through anything that is diggable—has conquered frozen ground, caliche, hardpan, coral rock, and even macadam pavement.

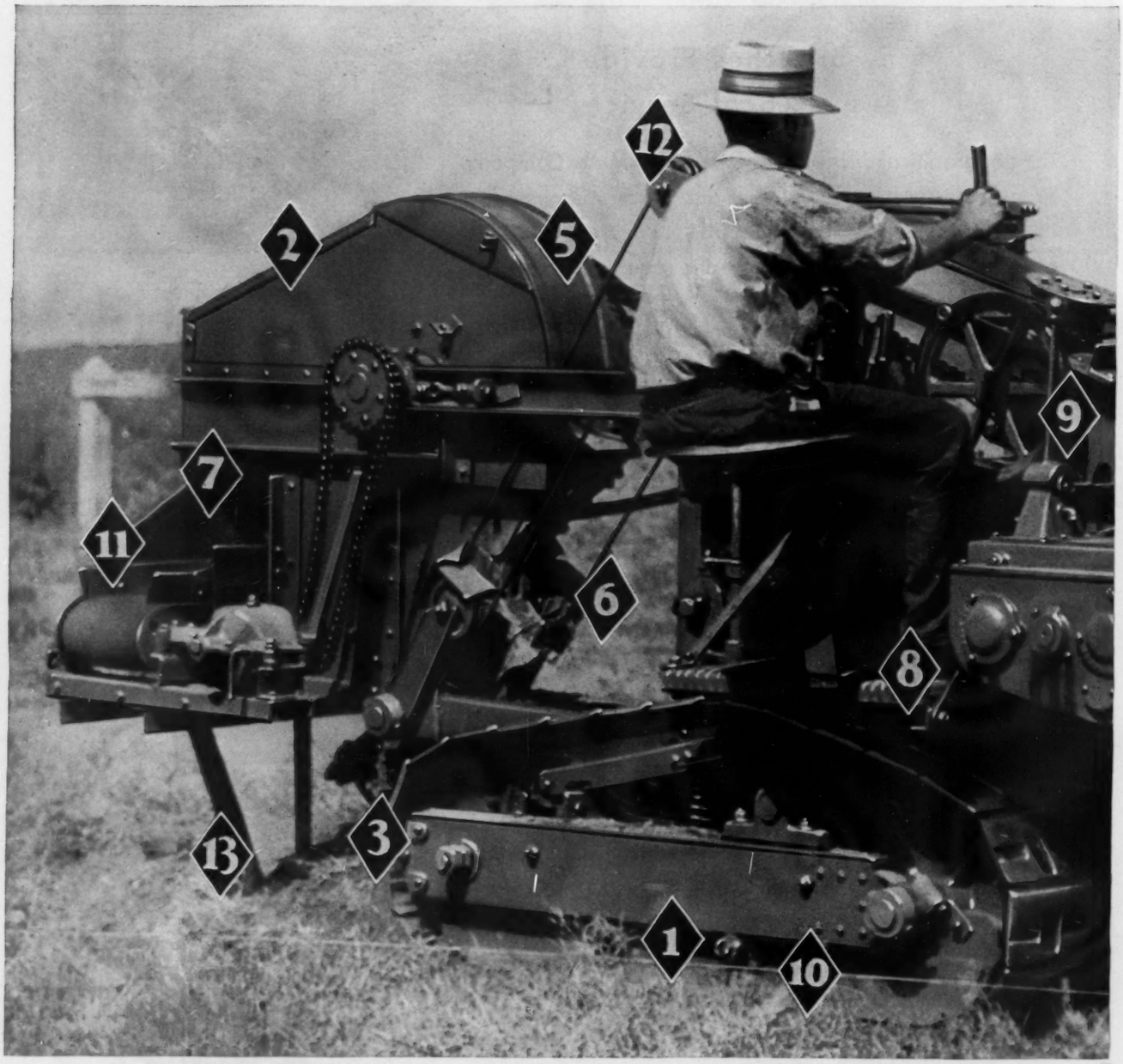
4 Buda Hivelo Engine, high compression design, for maximum efficiency and low fuel consumption—manual control, variable speed governor provides perfect power control for maximum digging efficiency.

5 The Mechanical Brain—adjustable overload release sprocket—automatically guards the Service Special from shocks of hitting underground obstructions, from the strains of hard digging—and it protects underground pipes and conduits from breakage. This sprocket lets go and re-engages automatically.

6 Chrome-Nickel Alloy Digging Teeth, interchangeable with other Barber-Greene Ditchers.

7 New automatic bucket cleaning blade swings through wide arc, just as bucket passes over spoil conveyor: positive cleaning on even wet, sticky material and a minimum spillage. Bucket and cleaner links of manganese steel with chrome-nickel pins.

8 Drive chain to the jack shaft runs in oil—a typical modern Barber-Greene feature.



BARBER GR

STANDARDIZED MATERIAL HANDLING MACHINES

712 West Park Avenue

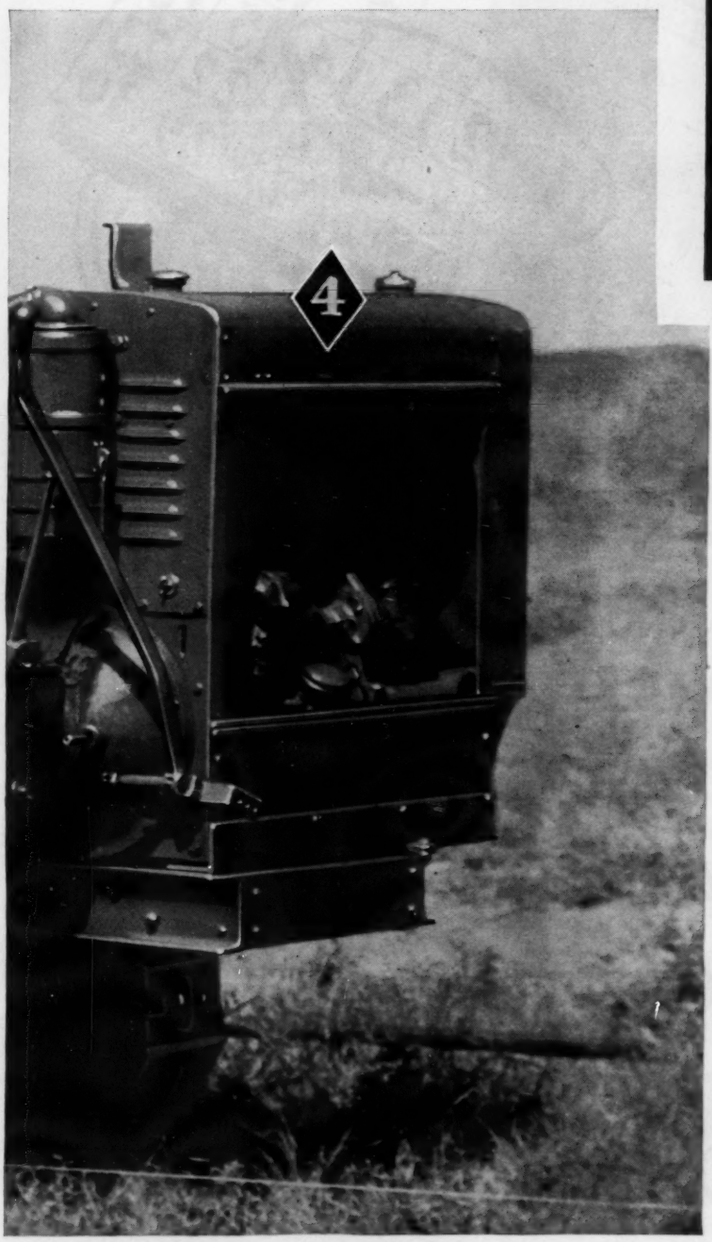
9 New selective speed, Barber-Greene transmission, three crawler speeds in either direction. An additional feeding transmission provides a total of 16 digging speeds.

10 Crawlers steer through 11″ internal clutches and 10″ brakes—each crawler can be operated independently of the other for sharp maneuvering.

11 Instantly reversible spoil conveyor—just throw a lever.

12 Boom is raised by power through automatic safety, cone-friction clutch.

13 Telescoping, non-jamming follow-up scraper with automatic spring throwout insures clean ditch.



Specializing in Inventing Faster, Cheaper Machines and Methods

Only 4 Feet Wide

▲ ▲ ▲

Speeds Thru Toughest Digging

There is not another ditching machine in the world like this New Barber-Greene Service Special—no not one. Here is what it gives you:

An unbelievably low investment—price is only $2800 f. o. b. Aurora, Illinois.

Light weight, only 7,500 lbs.; easier, faster moving from job to job.

Because this machine is small and light it uses far less gasoline—another saving.

Because it digs 5 to 8 inches wide it disturbs a smaller area: this means less spoil to refill, less sod to replace, less pavement to replace—all big savings.

Digging a narrow ditch means less material to handle—and more feet per hour and per day—standard machine geared for 14 feet per minute maximum.

Overall width only 48 inches — so small that the Service Special gets in and out and around tight corners like a wire-haired terrier.

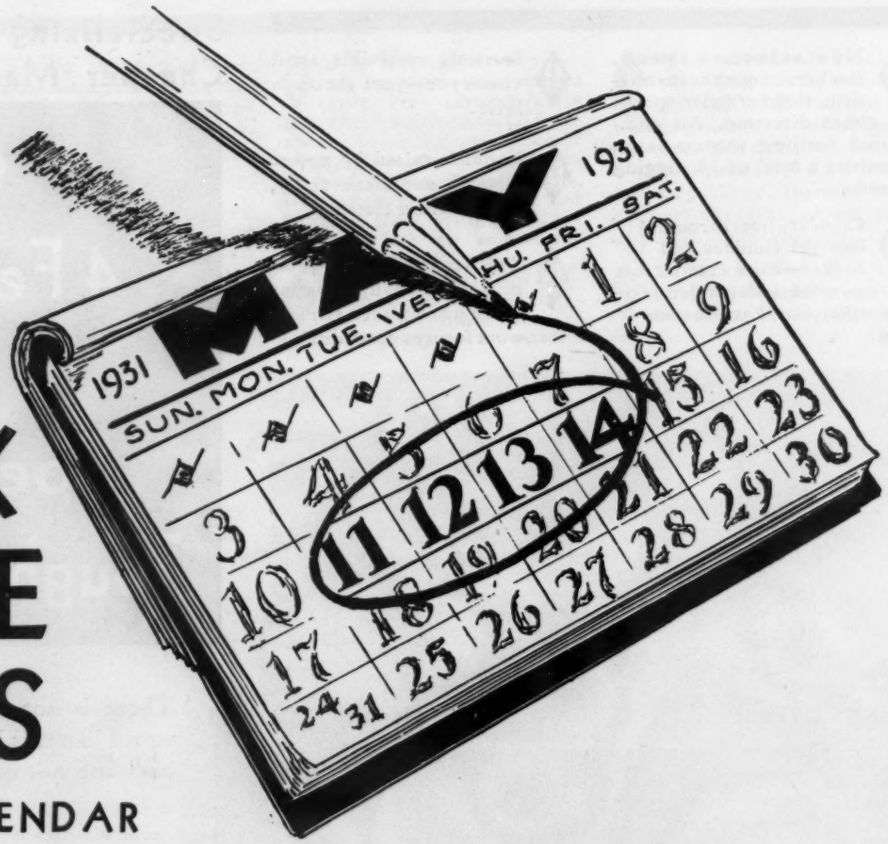
And the features of design, indicated by the B-G Pointers, tell you why this machine does what it does, faithfully, day in and day out—why even 3,000 and 4,000 straightaway feet per day can be knocked out week after week—why hidden underground pipes are safe—how maximum digging efficiency is assured—why such things as macadam, rock formations and frozen ground are merely incidents, and not stopping points.

Ask for Bulletin 64 for complete information.

EENE

Aurora, Illinois

Standardized Belt Conveyors — Portable Belt Conveyors
Portable and Self-propelled Flight Conveyors
Self-propelled, Self-feeding Bucket Loaders
Flight and Belt Car Unloaders — Snow Loaders
Vertical Boom Ditchers



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ON YOUR CALENDAR

TO ATTEND THE

ANNUAL

CONVENTION

of the

NATURAL GAS DEPARTMENT

American Gas Association

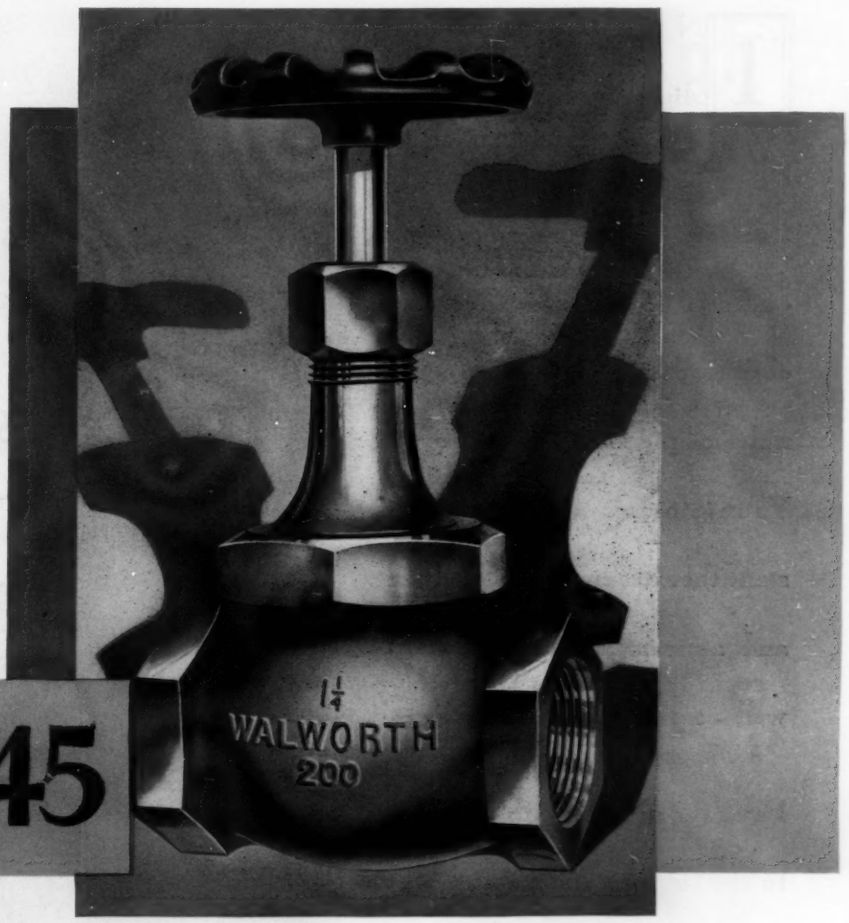
A constructive program with addresses by leaders in the industry. Entertainment features that will fulfill your expectations of Southern hospitality » » » » » »

MAY 11th - 12th - 13th - 14th

MEMPHIS, TENNESSEE

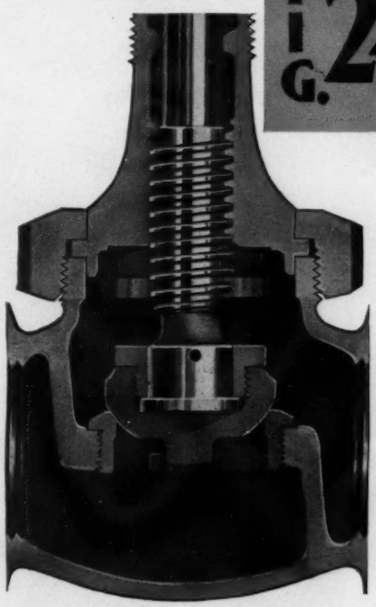
Hotel Peabody
CONVENTION HEADQUARTERS

MEMPHIS POWER & LIGHT COMPANY



One of the WALWORTH Quality Group BRONZE VALVES

FIG. 245



WALWORTH 200-lb. BRONZE GLOBE VALVE

This hard bronze globe valve, with its renewable, regrinding seat and disc, is one you can always count on for dependable service.

Recommended for 200 pounds working steam pressure, the Walworth Fig. 245 is equally effective in oil, water, air and gas lines. Its nickel-alloy seat and disc of Sigmalloy No. 222 are easily and quickly renewed and make the valve good for years of unfailing service under exacting conditions.

This is one of the Walworth "Quality Group" of Bronze valves which many engineers prefer for *all* their important installations. Details of this complete line of high quality valves will be found in the new Walworth Catalog 88.

WALWORTH

. . . Distributors in Principal Cities of the World . . .

General Sales Offices: 60 E. 42nd St., New York

WALWORTH CALIFORNIA CO., 235 Second St., San Francisco

WALWORTH COMPANY, 809 Fourth Place, Los Angeles

VALVES FITTINGS AND TOOLS

IN oil lines and gas lines . . . Youngstown pipe has long served with distinction in the transportation of both of these important commodities. Thousands of miles of pipe-lines have proved Youngstown's ability to withstand the extremes of soil, climatic and atmospheric conditions as well as rough field handling.

From the smallest gathering-line to the largest cross-country pipe line, every length of Youngstown steel pipe is carefully manufactured to give the longest service under the most adverse conditions . . . and do it at the lowest cost per mile. Youngstown pipe is strong, durable and easy to handle; it welds easily; and it saves time and money in installation. It is a sound investment. Use Youngstown Electric Weld, Seamless or Lapwelded pipe for complete satisfaction.

. . . . *for* **OIL LINE**

or

GAS LINE . . . . .

• YOUNGSTOWN •

GALVANIZED SHEETS PROTECT · SAVE WITH STEEL

THE YOUNGSTOWN SHEET AND TUBE CO.

One of the oldest manufacturers of copper-steel, under the well-known and established trade name "Copperoid"

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◆

INTERNATIONAL SUPPLY COMPANY
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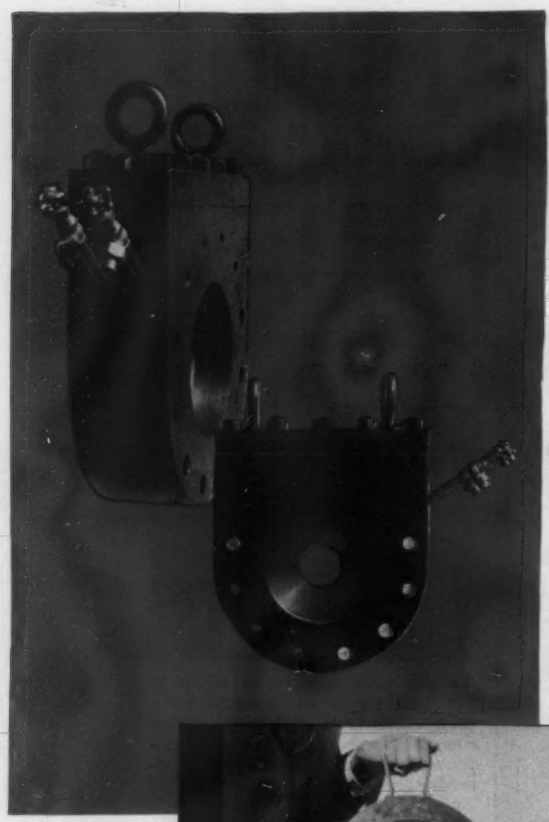
2122 East 7th Street, Los Angeles, Cal.

The Pictures of America's Gas Lines show DRESSER COUPLINGS in almost every one

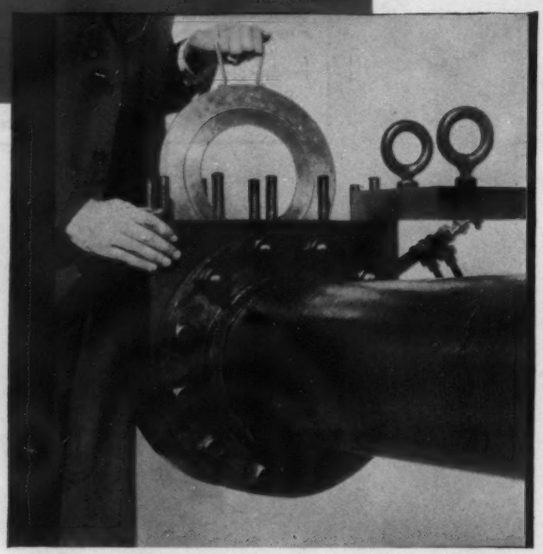
As the vast panorama of over 100,000 miles of Dresser coupled lines is unrolled, you witness that every joint is absolutely and permanently tight—yesterday, today, and tomorrow!

S. R. Dresser Manufacturing Co.
Bradford Pennsylvania

DRESSER COUPLINGS Dominate!



Many SAVINGS with this ORIFICE FITTING



Upper photograph shows the extreme compactness and simple, rugged construction of the Papico Orifice Fitting. The orifice plate is locked in a centralized position, preventing leakage passed the plate. The lower photograph shows the ease with which plates may be removed for changing or inspection. Less than five minutes' time required to make a complete change. No special tools are needed and the meterman can, without assistance, do the entire job.

Papico Orifice Fittings combine the advantage of quick plate change with installation economy. Plates are securely held in a centralized position, assuring accurate metering of all liquids or gases. No gaskets are disturbed during changes. Meter tube outlets are provided in the fitting for use when flange connections are desired. Complete plate changes can be accomplished in less than five minutes' time without the use of special tools. Plate removal is not hampered by close proximity to walls or other obstructions. Papico Orifice Fittings can be installed on all pipe lines in less time and with least expense. Complete information will be sent on request.

Papico Engineers are available to aid in the solution of metering problems without obligation. Other Papico Products include: Gas Odorization Equipment; Flow Tubes for use with Self-contained Fittings; Multi-tube Straightening Vanes; Perfection Duplex Mercury Traps.

Pacific Pipe & Supply Company

1002 SANTA FE AVENUE PAPICO LOS ANGELES, CALIF.

SUPERIOR MATERIALS

The quality of any product has its foundation in the quality of its raw materials. EMCO uses only the finest materials safeguarded by our own chemical and physical laboratories.

EXPERIENCE

45 years of experience in producing quality meters and regulating equipment for the gas industry.

DESIGN

Pioneers of ideas—(1) rolling type diaphragm (2) one piece body casting (3) removable valve plate assembly (4) pressed steel case (5) interchangeable parts, etc.

ORGANIZATION

The Pittsburgh Equitable Meter Company, manufacturers of the largest and most complete line of meters and pressure regulating equipment in the world, employs over 2,000 and uses the most modern manufacturing equipment to enable these employees to build only the finest products.

SERVICE

Trained engineering field staff, competent sales representatives, experienced engineers, and 12 strategically located branches with stock points, all go toward giving better service to the gas industry.

PITTSBURGH EQUITABLE METER COMPANY

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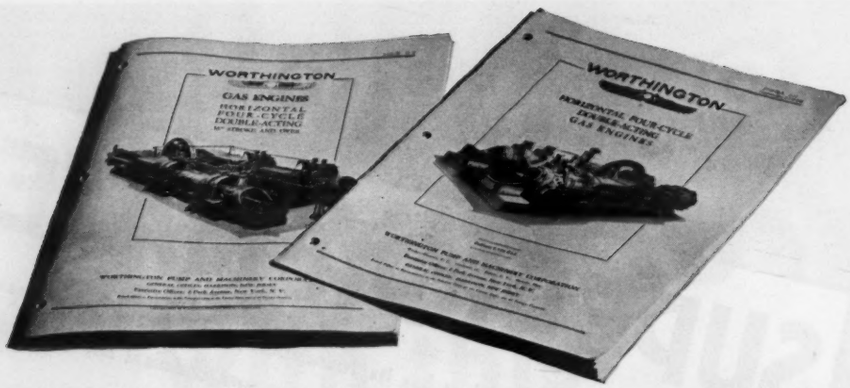

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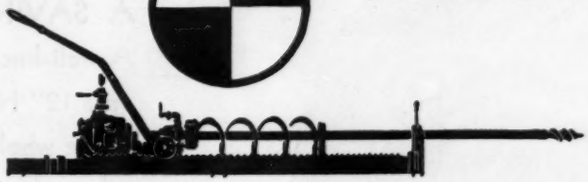

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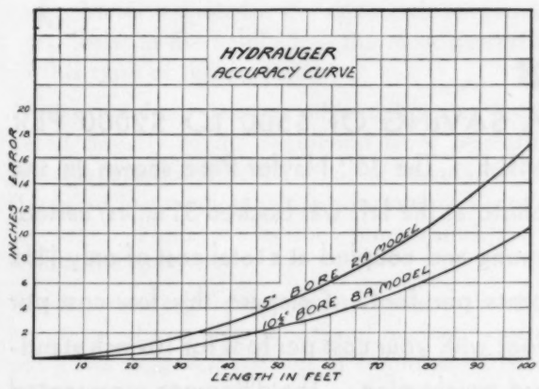

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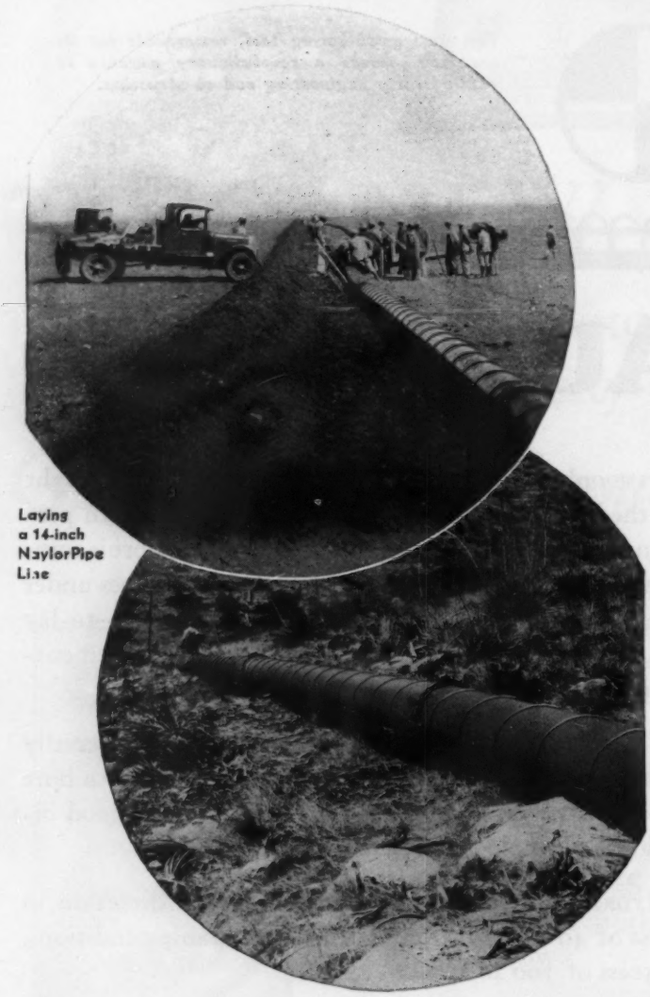

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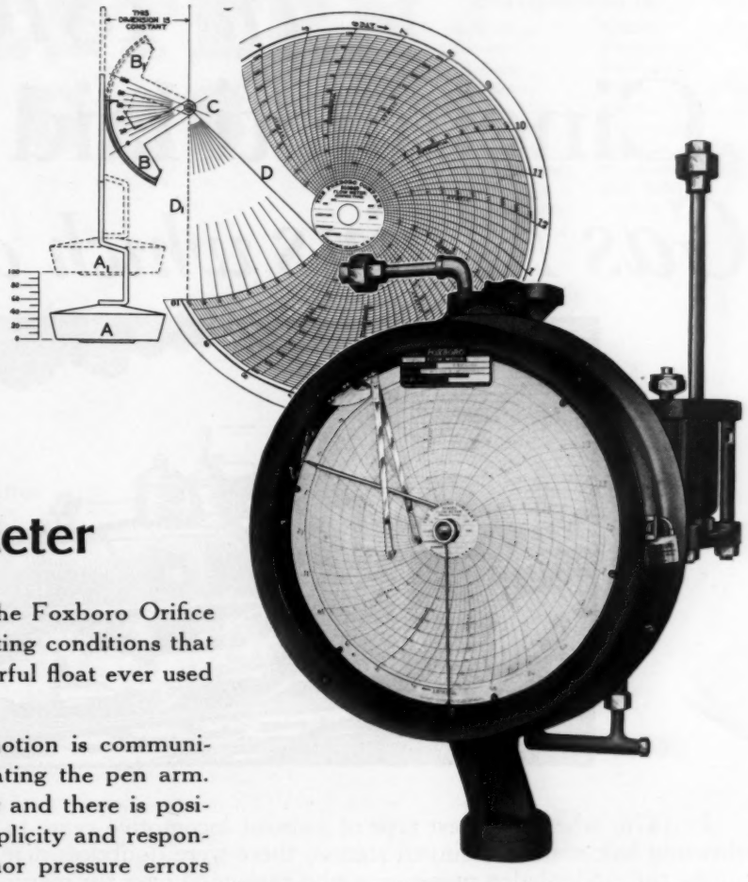

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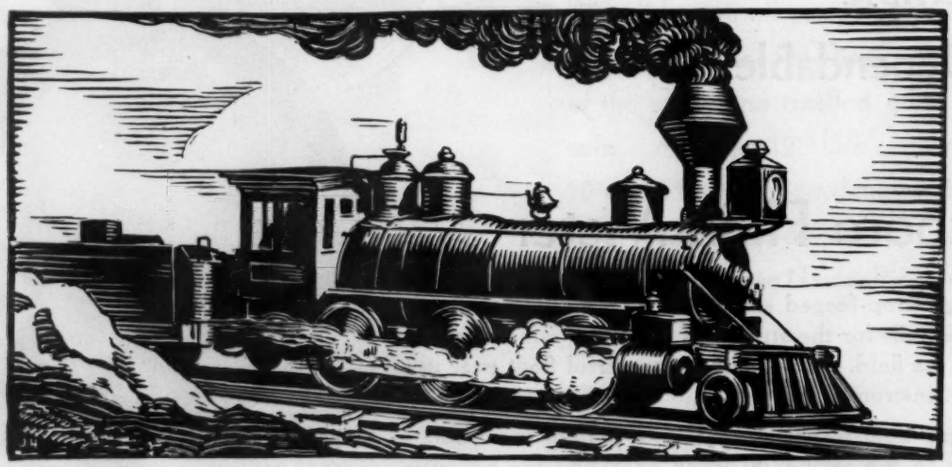

In 1876, when the latest type of railroad locomotive came to a wheezing halt at the Cincinnati station, there were doubtless many among the cinder-laden passengers who exclaimed over the marvels of railroad transportation.

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WESTERN GAS is published by Western Business Papers, Inc., at 124 West Fourth Street, Los Angeles. Subscription price (in advance) 20 cents the copy; $2.00 per year; 3 years $5.00; $3.00 per year foreign. Entered as second-class matter June 1, 1925, at the postoffice at Los Angeles, California, under the Act of March 3, 1879. Copyright, 1931, by Western Business Papers, Inc.

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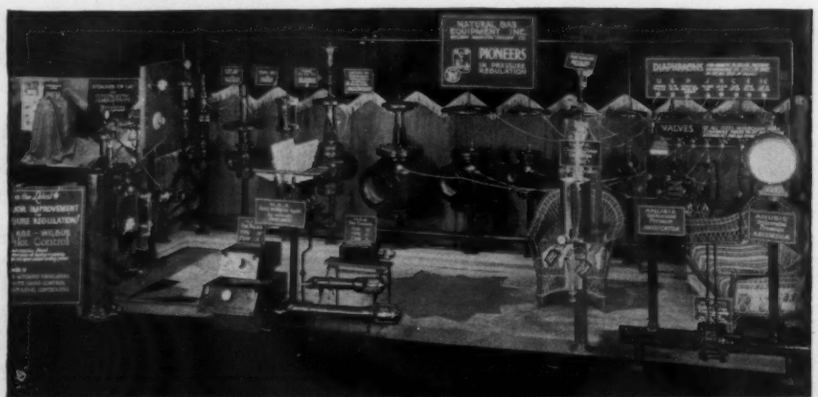

N. G. E. display at second annual Oil Equipment & Engineering Exposition, Los Angeles. N. G. E. Liquid Level Controller; Pilot Control; Gas Burners Types A, M, W, 10, 11, and R; Charcoal Steam Distillation Unit; Anubis Differential Pressure Indicator and Recorder; and Wilgus Pressure Regulators shown.

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A Monthly Journal of the Gas and Gas Appliance Industries in *Western America*

SAN FRANCISCO **LOS ANGELES** **DALLAS**

Review of the Month

ONCE more the utility merchandising issue crops up in national headlines, with several states reporting measures introduced in their legislatures on some phase of the subject. There is nothing new in this general activity; introducing bills to limit or prohibit merchandising effort by gas and electric companies is a pastime which has been indulged in ever since utility sales began. And killing off this type of legislation has followed practically without exception where the utilities have been on the alert to present the facts in the case.

California Inman Bill

California's Inman Bill (Senate Bill No. 275), introduced on January 19, and killed in committee on March 26, is one of the latest manifestations of anti-merchandising agitation. Because California utilities arrayed their facts and presented their case in a particularly able way, more will be said at a later point on the course of the Inman measure.

In several other states measures of similar intent to that of the Inman Bill are being considered, or have been either killed or enacted. The following outline is believed to include most of this activity which is of current interest:

Nevada: A measure to prohibit public utilities from engaging in the merchandising business, passed by the House, killed by the Senate.

Oklahoma: An act to prohibit utility merchandising, signed by the governor.

Iowa: Bill now in committee, to prohibit all utility merchandising.

Nebraska: Bill to prohibit utility merchandising reported unfavorably from House committee; an effort by the committee minority favoring bill, to put it on the general file for action was voted down in the House by a substantial majority, on Mar. 11.

Kansas: Measure prohibiting utilities from selling merchandise passed by Senate.

The case of the California utilities will interest the industry, as the most recent definitive action on the merchandising issue.

Practically all gas and electric companies operating in the State were represented in the hearing of March 26 before the public utilities committee of the Senate, which had the Inman Bill for consideration. Represented in the opposing group favoring the bill were coal dealers and various retail dealer organizations. The utilities of southern California delegated Le Roy M. Edwards, general counsel of the Southern Counties Gas Co., to present their brief. Representatives of northern California utilities and dealer organizations brought additional evidence to bear against the measure. A mass of data, effectively organized and presented, was offered the Senate committee to substantiate these facts:

That the proposed act was unconstitutional, as covered either expressly or by implication in company charters, and upheld in earlier decisions within the State; supported likewise by such notable decisions as that of the Pennsylvania Supreme Court in December 1928, Commonwealth of Pennsylvania vs. The Philadelphia Electric Co.

That the proposed legislation would take from the utilities the chief medium for the development of their business.

That the utilities, having the greatest incentive, are most aggressive in and best equipped for developing business on their lines—particularly as applies to pioneering new appliances, maintaining a high type of merchandise sold, and developing new territory. As an instance of promotional effort, the committee's attention was called to the current year's million dollar budget for gas and electric utility advertising in California.

That while utilities supply the merchandising momentum, they nevertheless do a minor share of the selling—30 per cent for electric utilities the country over; 20 per cent for typical southern California gas company sales. The balance is done by dealers, and dealer sales to a marked degree follow the curve of utility merchandising promotion.

That increased gas and electricity consumption results directly in lowered rates to the user; and conversely, that restricted utilization, which would follow the proposed measure, of necessity would bring higher rates.

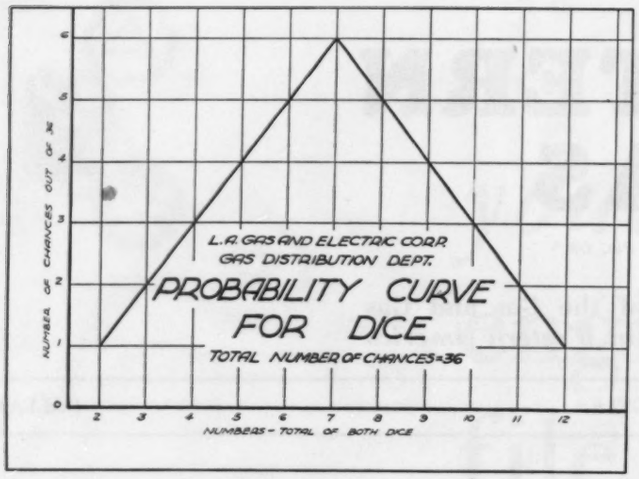
That the type of legislation proposed would disturb established trade channels, turning 700 employees now engaged in utility appliance sales work, out of employment, and "killing the goose that laid the golden egg" for dealers now realizing profitable appliance business as a result of utility sales activities.

The facts laid before the California Senate committee are common knowledge to the utilities—but not to the layman legislator. That such facts can be made to bear their proper weight is demonstrated anew in the California example. The logic of bringing such facts into the open, and taking a solid stand in defence of the right and necessity of merchandising, is equally apparent. And, be it said, there is a country-wide need for meeting this merchandising issue before it comes to a legislative head. This can be done by intelligent publicizing of the essential economics, which demand that merchandising effort continue unabated.

The course of such legislation in some states, where preponderant majorities have opposed utility merchandising, indicates chiefly one thing: That utilities in these sections have failed to get a hearing for the facts.

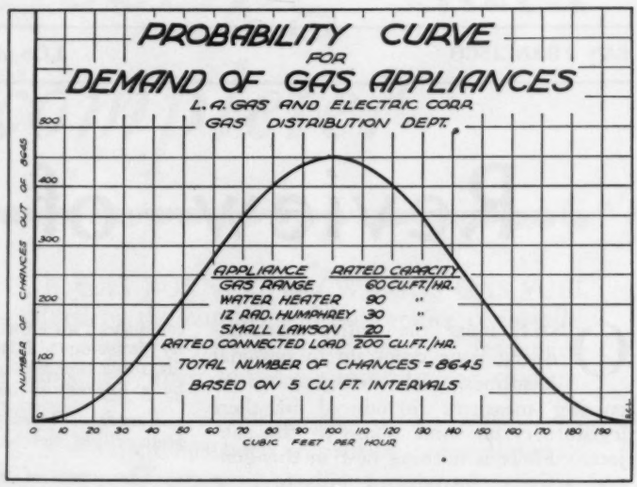
G. H. F.

Shall We Take Design


L.A. GAS AND ELECTRIC CORP.
GAS DISTRIBUTION DEPT.
PROBABILITY CURVE
FOR DICE
TOTAL NUMBER OF CHANCES=36
NUMBER OF CHANCES OUT OF 36
NUMBERS - TOTAL OF BOTH DICE

GRAPH. I

(Above)


PROBABILITY CURVE
FOR
DEMAND OF GAS APPLIANCES
L.A. GAS AND ELECTRIC CORP.
GAS DISTRIBUTION DEPT.
APPLIANCE RATED CAPACITY
GAS RANGE 60 CU.FT./HR.
WATER HEATER 90 "
12 RAD. HUMPHREY 30 "
SMALL LAWSON 20 "
RATED CONNECTED LOAD 200 CU.FT./HR.
TOTAL NUMBER OF CHANCES = 8645
BASED ON 5 CU. FT. INTERVALS
NUMBER OF CHANCES OUT OF 8645
CUBIC FEET PER HOUR

GRAPH II

(At Right)

APPLYING the laws which govern "rolling dice" to modern gas distribution design is an idea which will give pause to most engineers. Norman L. Hoff in the accompanying paper, prepared for the Pacific Coast Gas Association Technical Section's meeting at Los Angeles last month, uses the dice to demonstrate his point—that the "theory of probabilities" has practical application in distribution engineering.

At the 1930 convention of the Pacific Coast Gas Association the Distribution Design Committee, of which Mr. Hoff is chairman, presented a highly mathematical report offering a method for solution of the diversity problem. Final mathematical results were not available when this report was presented, and it is the committee's purpose to complete the subject at this year's convention. The present paper offers a non-technical discussion of diversity, which will appeal to everyone, mathematically inclined or otherwise.—*Editor.*

IT has been common practice in the past to consider diversity as a factor or ratio. This factor or ratio was applied as a multiplier or divisor to the total rated capacity of the gas appliances. The numerical evaluation was usually accomplished by a study of experimental data such as the records of demand meters. The obtaining of diversity factors in this manner, however, has several rather serious drawbacks. In the first place a demand meter study taken from an existing installation is at best only a check on a design that can not easily be changed. It is like locking the barn after the horse has been stolen. In the second place the extreme rarity of exactly duplicate conditions of supply and demand usually leads to much mental revision and modification of the experimental factors before they can be applied to proposed installations and even then confidence in the design selected is usually lacking. In seeking for a more satisfactory solution of diversity factors the Chairman of the Distribution Design Committee some three years ago conceived the idea of applying "The Theory of Probabilities."

N. L. Hoff

To those who are not mathematically-minded the computation of probabilities is apt to seem abstract, non-practical, and even a little nonsensical. However, the famous French mathematician, Laplace, once stated that the "Theory of Probabilities" consisted simply of good sense reduced to a system of calculation. Every intelligent human mind bases its expectations of the outcome of an anticipated event upon past experience, whether or not calculus is employed to figure out the relations. The mind, perhaps unconsciously, accepts the relations of probability as a foundation of judgment respecting future events of a similar nature. The doctrine of probabilities simply erects this inherent tendency and necessity of all minds into a general and organized scheme of numerical expression.

Consider for a moment the word "probable." Is it not true that it is almost invariably associated with some future event? For example, we often say, "It will probably rain before long." We base, perhaps unconsciously, the probability upon the overcast condition of the sky and upon a certain feel in the air which our past experience has taught us to associate with coming rain storms. The mathematician, not content with a mere guess, gathers data on the season of the year, the barometric pressure, relative humidity, wind velocity and a record of past observations of rainfall for that particular location, so that in the end he is able to say quite definitely that there are so many chances that it will rain as compared with so many that it will not.

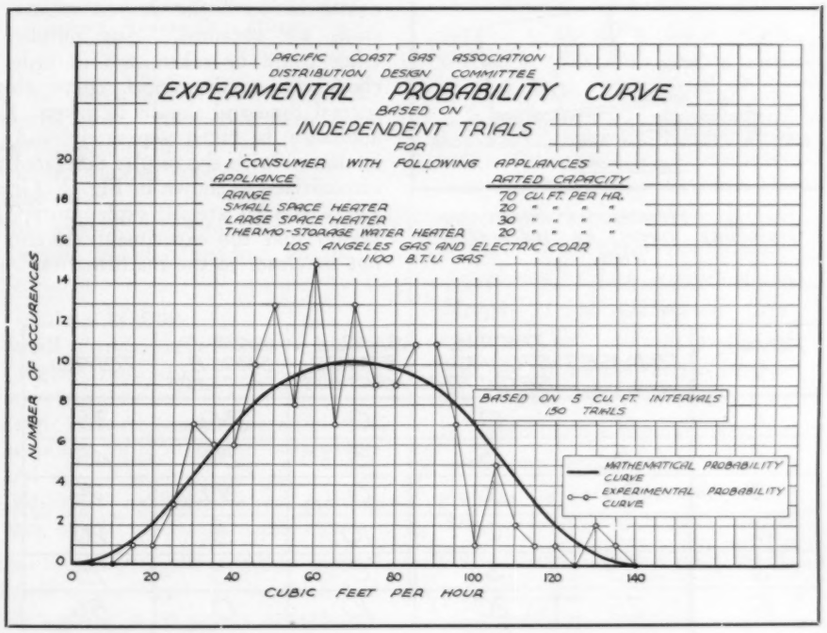
Skepticism is a universal human trait in respect to things like the probability theory, which accomplishes apparently miraculous results and which is very little understood by the average layman. It would be well, then, to examine an application of this theory to a problem which can easily be understood and hence serve as a good basis of judging the true worth of the application. Since probabilities have possibly received a broader application in the field of gambling than in any other, therefore let us examine an elementary problem of that character. The ancient game of casting dice furnishes a very fine as well as comparatively simple example of the application of probabilities to gambling.

No doubt, it would be needless to en-

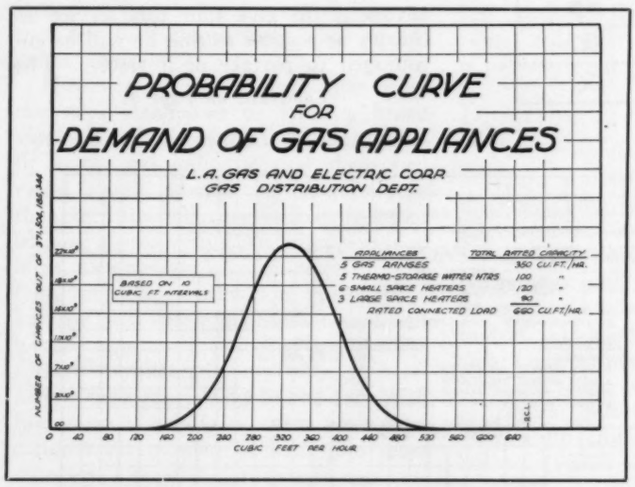
a Gambler's Chance *in the of* Distribution Systems?

By NORMAN L. HOFF

Assistant Engineer
Los Angeles Gas and Electric Corporation



ter into a detailed description of the method and object of casting dice; nevertheless, it would be well to point out that the event of primary interest is the sum of the spots on the uppermost faces of the two dice after they have come to rest following the cast. Since each die has six faces, each having a different number of spots, it is obvious that the sum may take any one of a number of different values. Graph I is a mathematical probability curve for a perfect set of dice, that is, dice having no bias. Naturally, loaded dice would not follow the laws of probability unless the effect of the loading were known. What is a probability curve? It is a graphical analysis of the number of ways an event can occur in comparison to the probability of it occurring any one of the various ways. From the probability curve (Graph I) it will be noted that 7 is the most probable combination to appear on the uppermost faces. Also 2 and 12, both with the same probability, are the least probable to appear. A little study of this curve will show that the caster of the dice has twice as many chances of winning as losing on the first roll, but he has three times the chances of neither winning nor losing but of being compelled to try for his point. Likewise it is easy to see that the chances of making the point are not favorable because the 7, the old jinx, is at the peak of the curve. The wise gambler, then, like the professional gambling house, prefers to bank the game against all comers and never touches the dice himself. The preceding statements, based on the mathematical probability curve, may be borne out by the same experiment which Weldon, one of the old mathematicians, once conducted; he cast a pair of dice 50,000 times, and his experimental probability curve checked the curve in Graph I, within a very small margin of error.


PROBABILITY CURVE
FOR
DEMAND OF GAS APPLIANCES
L.A. GAS AND ELECTRIC CORP.
GAS DISTRIBUTION DEPT.
BASED ON 10 CUBIC FT. INTERVALS
APPLIANCES
TOTAL RATED CAPACITY
5 GAS RANGES 350 CU. FT./HR.
5 THERMO-STORAGE WATER HTRS. 100 "
6 SMALL SPACE HEATERS 120 "
3 LARGE SPACE HEATERS 90 "
RATED CONNECTED LOAD 660 CU. FT./HR.
NUMBER OF CHANCES OUT OF 371,504,185,344
CUBIC FEET PER HOUR

GRAPH IV

(Above)

GRAPH III

(At Left)

Graph II is a mathematical probability curve for the demand of a small group of gas appliances based on certain fundamental assumptions which were set forth by the Distribution Design Committee in their report last year. Graph III is also a probability curve for the demand of gas appliances, only for a somewhat larger group. Without going deeply into the fundamental assumptions it may be stated that the chances in Graphs II and III are based on the combinations of loads that it is possible to obtain by setting each one of the gas appliances at different rates in cubic feet per hour. It does not require a probability curve to figure out that there is only one way of getting a load equal to zero cubic feet per hour (all appliances off) or a load equal to the rated connected load (all appliances on to their fullest capacity). But it does require a proba-

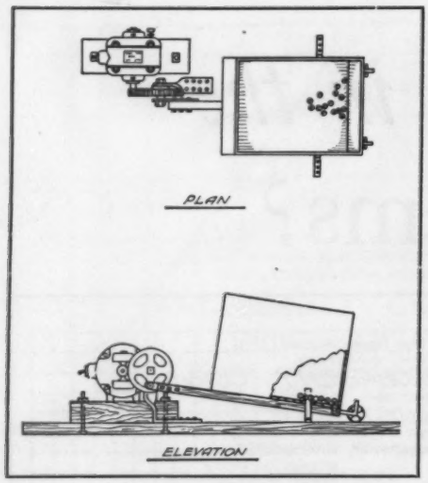


Fig. 1. Apparatus for determining probability curves by independent trials.

ber of ordinary glass marbles, each bearing a figure corresponding to a rate in cubic feet per hour for the gas appliance to be studied. In running a test the motor is started and the marbles are allowed to mix thoroughly, after which the hand is placed within the box and the first marble to be caught in its flight across the box is withdrawn and its number noted. Afterward it is again placed in the box. This procedure is continued until the desired number of trials are obtained. Any number of trials could be taken, but in order to check the mathematical curve closely several thousand should be taken. Each appliance is taken separately and the trials run with the results tabulated and summarized as shown in Fig. 2. Graphs IV, V and VI are self-explanatory. The reason that the experimental points do not lie closer to the mathematical curve is due to the extremely limited number of trials; nevertheless, the trend can be plainly seen.

Any complete probability curve contains all possible probabilities in connection with the event which is portrays; therefore, if the event can happen it will lie on the probability curve when it does happen. It is obvious, then, that all points on the curve combined constitute certainty. Or to state it mathematically, the sum of the ordinate values is equal to certainty. The application of probability curves to problems in distribution design, then, consists simply of equating a Design Load to an established degree of certainty.

In designing a piece of distribution equipment to supply the demand of a number of gas appliances it is necessary to insure sufficient capacity so that the loss of pressure caused by the demand will be within reasonable limits. Since these limits are usually prescribed by law there can be no uncertainty with regard to their determination. The quality of the utility's service is judged largely by its diligence in staying within these limits; hence in determining the degree of certainty that should be used in connection with the probability curves, this fact should be borne in mind. On the other hand, the price the consumer pays for the service is based to quite an extent upon the utility's investment in supplying him. Quite naturally the consumer wants good service for his money. From a business standpoint it is to our advantage to give him this service as cheaply as possible so that he will be encouraged to partake of it freely. The

(Continued on Page 42)

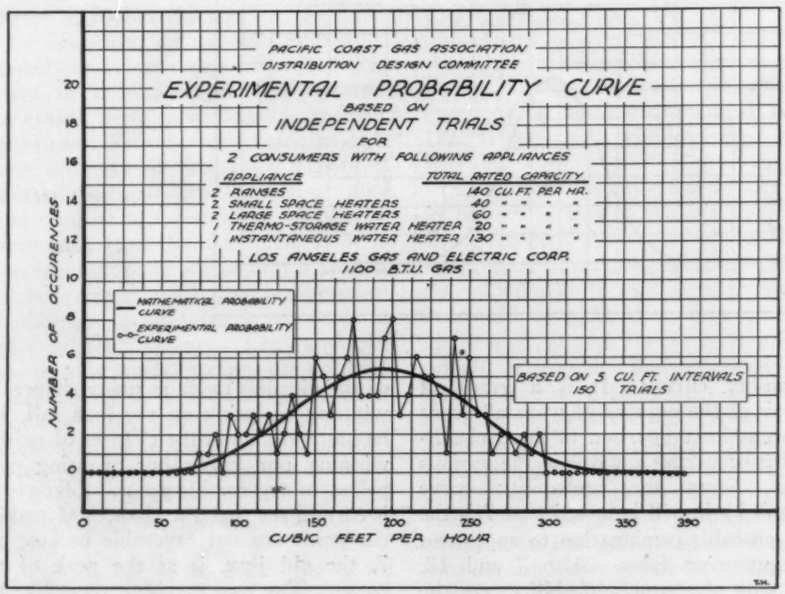
TRIAL N°	RANGES	THERMO STORAGE WATER HTRS	SMALL SPACE HEATERS	LARGE SPACE HEATERS	TOTAL
1	5	0	0	30	35
2	5	15	5	20	45
3	25	20	0	30	75
4	5	0	10	5	20
5	55	5	0	15	75
6	25	20	10	0	55
7	50	15	5	10	80
8	5	0	15	15	35
9	50	15	10	15	90
10	15	10	10	25	60

Fig. 2 (Above) Summary of independent trials for experimental probability curve. (For appliances see Graph IV).

bility curve to show that the most probable load is just one-half of the rated connected load, and that loads above and below one-half of the rated connected load have identical probabilities.

To demonstrate the truth of the preceding statements, based on the mathematical probability curves, the author built a probability machine for gas appliances and plotted experimental probability curves. By this means it was found that the experimental probability curves tend to check very closely with the mathematical curves.

Fig. 1 is an illustration of the so-called probability machine which was used in order to plot Graphs IV, V and VI. It will be noted that it consists essentially of a small box attached to the periphery of a gear wheel which is rotated by an electric motor, thereby imparting a vigorous shaking motion to the box. Inside the box are placed a num-



Graph V

Good Practice *in the* Utilization *of* Fuels

By H. A. ATWATER, M. E.

Chief Engineer, Combustion Equipment Company, Kansas City, Missouri

IT IS always essential for the fuel salesman to know where his commodity stands in reference to competing fuels, and it is the purpose of the discussion here presented to give a general analysis of fuel ratios. The author concerns himself particularly with fuels competitive to natural gas in the Oklahoma field, since his remarks were prepared for the Gas Division of the Oklahoma Utilities Association, which convened on March 11 at Oklahoma City. However, since various grades of coal and oil are the fuels treated in their major fields of competition to natural gas—domestic heating, small commercial jobs, and high pressure steam generation—Mr. Atwater's paper will be of value wherever natural gas is distributed. —Editor.

THE question of good practice in the use of various fuels is normally associated with the endeavor in the first place to choose good dependable firing equipment, and in the second place to apply this equipment to the boiler or heater so as to produce the most efficient firing performance. So far as it goes, this procedure is all very proper, but it gives no thought to the matter of comparative fuel ratios.

The gas man might argue that such fuel ratios are of secondary rather than primary importance because of the fixed nature of his rates. It is true that gas rates are usually fixed by franchise and the gas man has no recourse but to make the best of them. On the other hand the coal and oil men are not subject to any such restrictions, and can make any prices they wish with, of course, ultimate reference to factors of profit or loss resulting from the business. Due to this difference in conditions surrounding price factors, there is possibly more of an incentive for the coal and oil men to consider fuel comparisons and govern prices accordingly.

However, it would seem that from the sales standpoint or from a broad viewpoint of the ultimate greatest benefit to the gas industry, that these fuel ratios should always be given serious thought. It is all very well to feel that because a prospective consumer wants to burn gas or might already be burning it that fuel comparisons are unnecessary, but the fact still remains that coal and oil are constantly potential competitive fuels if commercially available. Therefore, where gas is sold in the face of a fuel ratio favorable to other fuels, any considerable number of such jobs must represent a possible future source of customer dissatisfaction. Looking at the matter of fuel ratios from this angle, it would seem that they merit very serious thought.

Many jobs involve factors which reduce fuel costs to a level of minor importance and in such cases it would be wasted effort to devote much time to fuel comparisons. But while such comparisons are valuable, it is unfortunately true that the rank and file possess very limited knowledge of competitive fuels or get into difficulty by using a certain ratio for conditions where it would by no means apply. In view of these facts, a general outline of average good practice under various conditions might be of some value.

The various fields for use of fuels can be split broadly into four groups as follows:

1. Domestic heating.
2. Small commercial jobs ranging roughly from 10 to 150 boiler horsepower.
3. High pressure steam generation such as plants of 150 boiler horsepower and up.
4. Industrial applications to melting pots, ovens, process furnaces, etc.

The fourth group is a highly specialized field in itself and one in which fuel cost frequently is of minor importance. In fact, many of these applications are so perfectly adapted to the use of gas as a fuel that hardly any other would be considered. For these reasons, this field is not discussed.

Domestic Heating

Taking up first the domestic heating field, the coal sold for this use is almost always a lump or sized grade, that is, the screenings or fine coal seldom find favor. The various grades range from bituminous coals to semi-anthracite, Arkansas anthracite, coke and petroleum carbon. It should be stated here that only fuels commonly available in Oklahoma are being considered. As a matter of correct information, the so-called "semi-anthracite" mined in eastern Oklahoma and western Arkansas is properly ranked as a semi-bituminous coal and the commercial "Arkansas Anthracite" mined in the eastern portion of this Arkansas field should be ranked as a semi-anthracite and not an anthracite coal. However, to avoid confusion, the commonly used, although incorrect, terms will be employed.

The heating values per pound of these coals will range roughly as follows:

11,000 to 13,500 for various bituminous grades.
13,500 to 14,800 for semi-anthracite.
13,500 to 14,000 for Arkansas anthracite.
12,500 to 13,500 for coke.
15,000 to 15,500 for petroleum coke.

In house heating service, it is naturally out of the question to expect any great amount of care in the firing of coal, the usual procedure being to fire as much at one time as possible and get along with the least number of trips to the basement. The bituminous coals are better adapted to higher combustion rates while the higher carbon coals handle very nicely on low combustion rates and under the practically continuous semi-banked firing operation which house heating represents. Therefore, the higher carbon coals give the higher efficiencies and better all-round performance. However, the bituminous coals are usually enough cheaper than the higher carbon coals to offset the difference in efficiency, and frequently these coals represent the lower fuel cost provided the user is willing to accept the greater amount of attention which should be devoted to firing.

Roughly, the efficiencies with bituminous coals will range from 30 per cent to 45 per cent, and on the higher carbon coals (which term covers all the remaining grades referred to) from 45

per cent to 60 per cent. This relatively wide range in efficiencies tends to discourage the development of average fuel ratios, but one compensating factor is that in house heating efficiency and fuel cost are usually less important than factors of freedom from attention, absence of dirt or dust, even heat, etc.

In passing it might be in order to state that at the present time the small coal stoker has not become much of a factor in house heating. This device requires such manual attention as filling of the coal hopper and removal of clinkers, which, coupled with a relatively high initial cost, make it difficult to compete with hand-fired coal plants or automatic oil or gas fired plants.

The second type of fuel available is oil. Commercial fuel oil requires heating in cold weather and is therefore not suitable for house heating. For this service, there is available furnace or distillate oil of around 38 to 40 degrees Baume gravity, and a heavier grade which is a gas oil usually within the limits of 29 to 32 degrees Baume gravity. The gas oil, which is commonly called "light fuel oil," is about as heavy as will flow in cold weather, and while it does not contain as many heat units per pound as the distillate, it will run more B.t.u.'s to the gallon, which is the basis of measurement. These heating oils will average 135,000 to 140,000 B.t.u. per gallon.

The distillate oil vaporizes readily when heated and a great many jobs utilize a simple casting set on the coal grates with an oil tank for gravity flow and a needle valve for hand-firing. This same grade of oil is also fired in a great many automatic burners built around a motor-blower design and operating on the off-and-on principle. The light fuel oil must be sprayed from a nozzle under pressure and is not well adapted to a gas pilot so that the automatic burners suitable for firing this oil are more complicated in design and carry a higher initial cost.

These oil burners are all conversion burners and therefore efficiencies developed are limited in the first place to the inherent efficiency embodied in the heater or boiler design. Efficiencies with these heating oils will range from 35 per cent to 65 per cent. The lower portion of this range covers most cheap hand-controlled jobs, while the upper portion applies to the higher grade automatic burners.

Natural gas will generally range from 900 to 1100 B.t.u. per cu. ft., depending upon the source of supply and also upon the extent to which the gas from the fields is run through natural gasoline plants. Under some market conditions, this last factor may be affected by the season of the year. To simplify these fuel comparisons it will be assumed to average 1000 B.t.u.

Depending upon the type of conversion, whether hand-fired or under automatic control, house heating efficiencies with gas fuel will range from about 35 per cent to 65 per cent on conversion jobs. As in the case of conversion oil burners, these figures are necessarily limited by the design of the furnace or boiler.

The special gas fired furnace and boiler designs usually will run in service from 65 per cent to 80 per cent efficiency. The advantage residing in the higher efficiency of these designs is offset by the sales resistance involved in overcoming the average customer's objection to installing a new central heating unit and particularly one which will handle only one fuel in territory where other fuels are available. The relative importance of these factors is very easily determined for any gas system by comparing percentage of sales for conversion and special gas fired jobs.

Considering all these domestic fuels, a rough average series of fuel ratios might be suggested as follows:

15,000 cu. ft. gas per ton bituminous lump or sized coal.

23,000 cu. ft. gas per ton higher carbon domestic lump or sized coal.

105 cu. ft. gas per gallon oil fired by hand-adjusted gravity oil burners.

140 cu. ft. gas per gallon oil fired by automatic oil burners.

The above ratios contemplate an automatic conversion gas job. For a hand-fired gas job, these ratios should be increased roughly 15 to 20 per cent, and for a special gas fired unit decreased to about 15 to 20 per cent. It should be understood that at best only an average can be struck and in this house heating field variations are frequently surprisingly great, but the general factors involved have been sketched out so that a revision of these ratios either way can be roughed out for any particular plant.

Small Commercial Job

Taking up the next general field, the small commercial job, the great bulk of these plants will be firebox, large size cast iron sectional, small horizontal return tubular, vertical, and Scotch-marine boilers. Most of these plants are steam with occasional hot water jobs. In addition, there will be encountered large blast type hot air heating units. However, only general average figures can be given for all these types, as it involves quite a lengthy study to develop the particular methods of treatment which should be employed for each type of boiler or heater.

Most of these plants fire coal by hand and the bituminous coal grades are far more popular due to price factors. Coke, petroleum carbon, and Arkansas anthracite are seldom fired in these plants. Where smoke complaints must be considered, semi-anthracite is commonly resorted to. Where a fireman is always available and draft and load conditions permit, screenings represent the cheapest coal fuel. Where the fireman visits the boiler room only occasionally, the better practice is to use mine run, nut run, or nut grades.

In down-draft boilers, a mine run coal works out very satisfactorily, as does also a mixture of bituminous nut and semi-anthracite slack. In general, this type of boiler should be fired with a coking coal. It might be in order here to warn against the mistake often made by a gas man unfamiliar with this type of boiler who looks just once at the firing doors wide open above the upper grates and thereupon guarantees an impossible saving on gas on the theory that no fireman can get very efficient results by leaving his firing doors wide open all the time.

The heating value of bituminous coals will range from 9500 to 11,000 B.t.u. for screenings sizes and from 11,000 to 13,000 B.t.u. for the larger sizes, such as mine run and nut run, while a good grade of nut will run as high as 13,500 B.t.u. Semi-anthracite slack usually averages from 10,500 to 12,000 B.t.u.

Perhaps it should be stated here that while these ranges in heating value might seem entirely too wide to one unfamiliar with coal fuel, this is due to differences in sizes of screens at various mines and is also affected by the location of any particular mine in the field. These heating values of course are on the "as received" basis, or just as the fireman gets the coal from the bin.

Efficiencies in these plants generally range from 35 per cent to 60 per cent. Where low combustion rates and considerable banking are necessary, the semi-anthracite gives higher efficiencies than the bituminous coals, and this same relationship holds for plants where the fireman is not on constant duty and loads the firebox full at every firing.

In recent years, the coal stoker has made rapid progress in designs for these plants and there is considerable ignorance as to how this factor fits into the picture. In the first place, it should be stated that in these relatively small plants a good fireman can develop as high effi-

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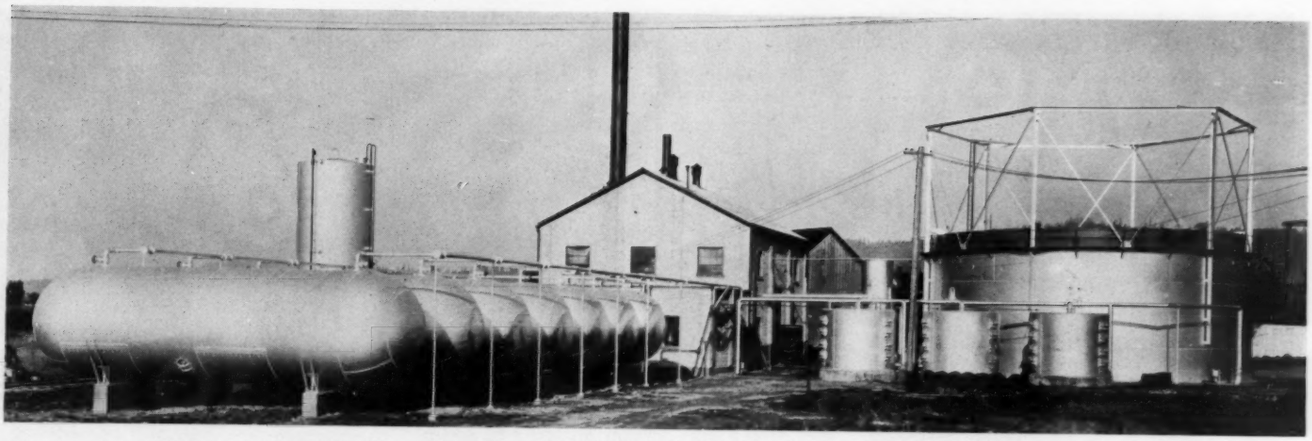

Western Gas Company of Washington's new plant at Longview, serving Longview and Kelso

Design *and* Operation *of* Longview-Kelso Water Gas Plant

By C. B. SHAKLEE

General Manager
The Western Gas Company of Washington

THE Western Gas Company of Washington, a new utility in the Pacific Northwest, completed and put into operation new gas distribution systems in the cities of Longview and Kelso in October, 1930. These two systems are connected by pipe lines under the bed of the Cowlitz River, and gas is supplied to both systems from one plant located in Longview, Wash. This plant is a bituminous coal and fuel oil carbureted water gas generating set.

A similar distribution system and gas manufacturing plant has also been constructed at Bremerton, Washington, and was put in operation during the month of March.

The gas works building is a fire-proof building on a concrete foundation, built of concrete brick with Manville fire-proof roofing, the main building being approximately 34 ft. by 55 ft. with 22 ft. walls on the main building, and 10 ft. walls on the fuel, compressor and lower room. The coal storage, along one entire side of the building, is built of concrete and has a capacity of several cars of coal at a time. The building has concrete floors throughout.

Fuel oil supplied is stored outside the main building in an upright storage tank with a capacity of 25,000 gallons—over two cars of fuel oil.

To briefly describe operating procedure, the first action is the process of weighing the coal both for boiler use and for the generator, over scales built in between the coal bins and the boiler and generator. This bucket of coal for

C. B. Shaklee

the generator is then hoisted by an electric hoist and carried on a circular track to a point over the generator, where it is dumped into the generator from the top. This is done by electric controls manually operated. One steel stairway and balcony around the top of the generator provide for handling the fuel into the generator.

The gas-making set consists of a generator and carburetor, and super-heater built within one shell. The entire unit consisting of generator, carburetor and superheater is 14 ft. high, 13 ft. long and 5 ft. wide, with circular ends and is built of ¼-in. steel. The sides of the shell are reinforced with 7-in. I beams and the top of the shell is reinforced with 4-in. I beams.

The generator chamber is provided with one 20-inch charging door at the top of the shell, and three 12-in. by 16 in. self sealing clinker doors, and one 12-in. by 16-in. ash pit door. The carburetor chamber has four and the superheater has two 12-in. by 16-in. self sealing doors for changing the checker brick.

The shell is fitted with double fire brick lining and 1½-in. asbestos cement lining between the fire brick and the shell to prevent the metal from overheating. The bottom of the shell is protected with 5-in. of fire brick, and the top of the shell is protected throughout with specially designed fire brick arch tile and asbestos cement. The heat in the generator ranges around 1500° and in the superheater and carburetor chamber around 1400°.

The generator, carburetor and superheater chambers are all provided with quick opening blast gate valves and are connected with large diameter air lines to the blower, which has a capacity of 2500 cubic feet of air per minute at a pressure of approximately 30 in. of water. This blower is driven by a connected 5-in. by 7-in. vertical enclosed self-oiling steam engine by means of a flexible joint.

The set is also provided with pyrometers and sight discs for the operators' benefit in maintaining the proper temperatures. These gauges, together with all other gauges and all other controls for pressures, temperatures, measurements, are concentrated on the instrument board located at a convenient point for the operator, between the boiler and generator. Venturi meters measure all air and steam going into the generator. For providing the steam a 100 h.p. 66-in.

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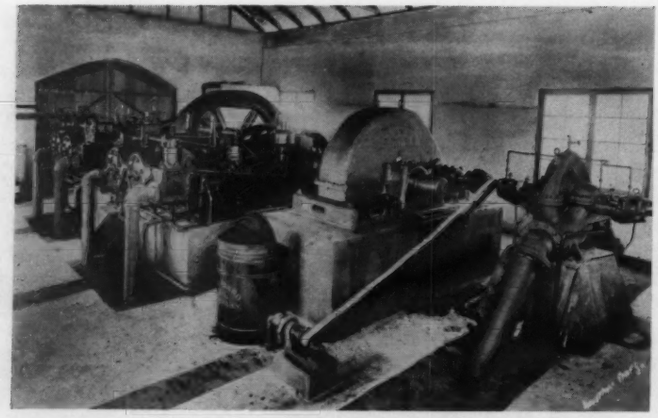
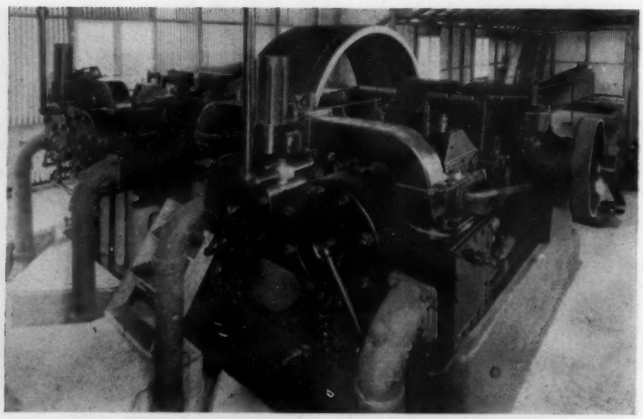




LEFT: 320 h. p. gas engine in pumping service for Glendora Independent Water Co., Glendora, Calif. RIGHT: Orange Acres Mutual Water Co., 400 h. p. gas engine. Both installations on lines of Southern Counties Gas Co.

Southern California's Experience in

Developing Gas Engine Sales

By C. REMSCHEL
Power Engineer
Southern Counties Gas Company

WITH the many miles of natural gas line extensions that have been made all over the United States within recent years, and the proposed extensions, supplemented with the ever-increasing natural gas supply, many new fields for the natural gas engine have been opened. Inasmuch as the gas engine is a very good load builder, and this load being very desirable business, we take this opportunity of passing on to those interested the experience of building up a gas engine load in Southern California, where, possibly, more has been done in developing this class of business than in any other similar territory. The work has not been easy; it has been a battle every inch of the way and will continue to be so. However, the results obtained are certainly worth the effort.

Many readers probably wonder why it is that the gas engine has taken so long coming into its own. The reasons are obvious, as the following brief history of the development of the gas engine will show.

Engine History in Brief

The first record of a gas engine dates back to the year 1794, when Robert Street developed a gas engine, employing a cylinder in which worked a piston connected to a lever, from which a pump was operated. Spirits of turpentine was used for fuel, which was ignited by a small flame through a touch hole.

In 1823 Samuel Brown, using an ordinary engine, utilized the difference in pressure between a partial vacuum and the atmosphere. This was created by condensing a flame in a vessel.

In 1833 W. L. Wright developed a double-acting gas engine, in which air and gas were suppled to the engine by two separate pumps at a pressure of a few pounds, ignition being managed by a flame and touch hole.

In 1838 William Barnett brought out an engine in which, for the first time, the inflammable gas and air were compressed before igniting.

In 1855 A. V. Newton, for the first time, brought out an ignition in the form of a hot thimble, the uncovering of which by the piston ignited the explosive gases.

In 1857 Barsantt and Mattenci came out with an engine, using a free piston in which the explosion lifted the piston. On its return, the piston would engage the driving shaft and transmit the energy, due to the dropping of the piston.

Up to this time the gas engine was in an entirely experimental stage and was of no commercial value.

In 1860 M. Lenoir achieved the honor of developing the first gas engine that was actually introduced to public use. This engine was exceedingly simple, and by 1865 from 300 to 400 of these engines, ranging from ½ to 3 horsepower, were in use.

In 1876 a German engineer, Otto, brought out what was known as the "Otto Silent" engine. This engine was in reality the forerunner of the present-day gas engine. This engine was established on a firm commercial basis, and more than 15,000 of these engines were sold, many of which can still be seen.

In 1880, or near that time, gas engines were modified so that gasoline could be used in them. Gasoline, at that time, was a worthless by-product in the manufacture of kerosene. This, in connection with the necessity of finding a more economical power for pumping in the oil fields, created quite an impetus in the development of the gas engine.

Up to this time, the gas engine was crude in design, heavy per horsepower, cumbersome, and costly. However, due to the ever-increasing demand for this class of power, and the interest in further development by the gas engine builders, improvements were rapid, with the result that we today have a gas engine able to give dependable and economical service. However, there is still room for further improvement, principally in the reduction of weight and first cost.

From the foregoing it is seen that only in the last few years has a satisfactory gas engine been available, and that only in recent years has a market been developed for the use of these en-

gines. In other words, the gas engine—heretofore in its infancy—is only now coming to be reckoned with in power requirements, along with its competitors, the electric motor, the Diesel and steam engines.

The public is naturally skeptical of trying something with which it is not entirely familiar. Furthermore, it is reluctant to break away from conventional practices, and it has therefore taken a great deal of effort to bring the use of gas engines to its present established state.

Half-Million H.P.

That territory in Southern California lying south of the Tehachapi, from the Pacific Ocean east to Redlands and south to Santa Ana, has probably the greatest gas engine development of any other like territory. There are more than 500,000 horsepower in gas engines installed in that area, of which about 100,000 horsepower are in use in agricultural and industrial work, and the balance in the oil industry in the various oil fields in that territory.

The use of gas engines in agriculture is principally for pumping water for irrigation. The industrial business covers gas engines for use in paper mills, glass factories, ice and refrigeration plants, municipal pumping plants, etc.

The gas engine business in Southern California was first developed in irrigation work by the water user, who, in looking for cheaper power when his water level dropped and his pumping cost became prohibitive, turned to the distillate engine for relief. This was about 20 or 25 years ago, and long before natural gas was available for this purpose. At that time distillate could be purchased for 2¾c per gallon, and, at that price, the user could make a substantial saving in his power cost by using a distillate engine. In time, however, the cost of distillate increased. This was when the automobile came into general use and the market for gasoline increased. For a short period it looked as if the day of the engine was doomed. However, it was not to be, for just about that time a number of new oil fields were developed and a great amount of natural gas brought in. This had to be disposed of; lines were built into the agricultural district; attractive rates were made; and the engines theretofore using distillate, that were able to be served, were picked up and operated on natural gas. They operated not only more satisfactorily, on account of the better fuel, but at a considerable reduction in operating cost, due to the low gas cost.

As the demand for gas engines increased, the engine builders improved their engines, designing them for use on natural gas. Today, the natural gas engine gives better service than any other source of power.

Satisfied Users

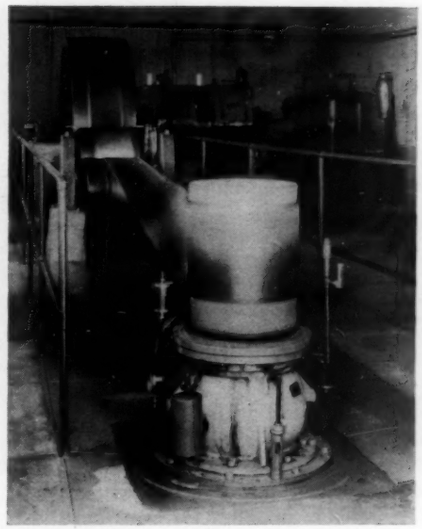
To demonstrate that the natural gas engine is making good and is favorably thought of by users in Southern California, the writer presents the names of several customers who have made repeat installations (additions to their original installation). Table No. 1 gives this information for typical irrigationists using gas engine power. In Table No. 2, similar information is shown for industrial users of gas engines.

Evidence such as that recorded in the above tables should warrant even the most skeptical investigating the use of natural gas engines.

The future of the gas engine business lies in the hands of the gas companies, and the gas engine builders; upon the activities of each and the cooperation of the one with the other. The gas company going after this business must realize that to build up a gas engine load is not simply a matter of order taking; that sending out untrained men is simply a loss of time and money. The salesman should be a man with mechanical training who is able to make the proper application and talk convincingly to his prospect. After the sale has been made, the gas company must see to it that the

GENERAL considerations which make the gas engine load extremely attractive to natural gas utilities were discussed in *Western Gas* for February, introducing a series of articles on gas engine sales. Mr. Remschel, power engineer for the Southern Counties Gas Co., contributes a second installment in this series. The author is particularly well qualified to treat the subject in hand, his experience including 10 years as sales manager for a firm manufacturing gas and diesel engines; 15 years in the electrical departments of Pacific Coast utilities; executive sales and consulting engineering experience in mechanical and electrical fields. Because he is thoroughly familiar with the competitive field, the sections of this discussion which present an analysis of gas engine versus electrical power are of special value—*Editor.*

C. Remschel



160 h. p. gas engine in domestic water pumping service for City of Monrovia, Calif., showing detail of hook-up to pump.

TABLE NO. 1. "REPEAT" INSTALLATIONS OF GAS ENGINES FOR IRRIGATION PUMPING POWER USE.

Glendora Independent Water Co. (Glendora)

1920	480 h.p.
1925	200 h.p.
1930	200 h.p.
TOTAL	880 h.p.

Riverside Highlands Water Co. (Riverside)

1921	120 h.p.
1925	160 h.p.
1926	300 h.p.
1928	400 h.p.
TOTAL	980 h.p.

Glendora Consolidated Mutual Irrigating Co. (Glendora)

1922	460 h.p.
1924	190 h.p.
1927	320 h.p.
1930	450 h.p.
TOTAL	1,420 h.p.

Citizens Land and Water Co. (Bloomington)

1922	480 h.p.
1924	160 h.p.
1926	360 h.p.
1927	560 h.p.
1929	200 h.p.
1930	40 h.p.
TOTAL	1800 h.p.

North Corona Land Co. (Norco)

1920	60 h.p.
1922	320 h.p.
1924	70 h.p.
1925	120 h.p.
1927	80 h.p.
TOTAL	650 h.p.

Yorba Linda Water Co. (Yorba Linda)

1920	240 h.p.
1922	260 h.p.
1924	240 h.p.
TOTAL	740 h.p.

TABLE NO. 2. "REPEAT" INSTALLATIONS OF GAS ENGINES FOR INDUSTRIAL USE.

Municipal Pumping

City of Monrovia (Monrovia)

1924	640 h.p.
1927	160 h.p.
Total	800 h.p.

Glass Factory

Highland Western Glass Co. (Fullerton)

1924	640 h.p.
1924	320 h.p.
Total	960 h.p.

Paper Manufacturing

Los Angeles Paper Mfg. Co. (Los Angeles)

1924	160 h.p.
1929	320 h.p.
Total	480 h.p.

Ice and Refrigeration

Puritan Ice Co. (Santa Barbara)

1924	160 h.p.
1928	320 h.p.
1929	800 h.p.
1930	200 h.p.
Total	1480 h.p.

engine functions properly, so that the consumer will obtain the service that he expects and to which he is entitled, and the gas company must see to it that the consumer is satisfied. In this way, and only in this way, it will be possible to build up a profitable gas engine load and retain it.

Building Better Engines

It has been quite clearly demonstrated that the greatest obstacle to building up a gas engine load has been the high first cost of the gas engine installation, and for that reason, the only business that has so far been available has been that which has had a good load factor on which the saving was sufficiently large to return the initial investment within a reasonable period. To overcome this, the gas engine builder has, in the interest of obtaining desirable business, frequently sold his engines, taking payment for them out of the savings in the cost of operation.

The greatest impetus that can be given the industry will be a reduction in the first cost of the gas engine. It is our opinion that this can, and will, be effected in the near future, and that there will be available a gas engine that will give equally as good, if not better, service than the present slow speed, heavy duty, horizontal engine for about one-half the cost, installed.

What is needed is a line of vertical multi-cylinder engines, moderately high speed, of about 1000 foot piston speed, conservatively rated, not over 70 lbs. MEP, economical in the use of both fuel and lubricating oil, not over 11,000 B.t.u. per BHP hour at, or near, full load, with limiting devices so that engines can not be overloaded more than 10 per cent. These engines should have a good appearance, should be quiet in their operation, and easy of access.

Manufacturers are now working to bring out a gas engine along these lines, at a moderate price, and will undoubtedly not only create a big demand for themselves, but for the gas industry as a whole. The engine we have in mind must not be confused with many of the high-speed, multi-cylinder, vertical industrial gas engines now on the market; these are not at all suited for continuous service and are designed for intermittent and mobile service only. Their use for continuous service should be discouraged.

In extreme cases where the prospect is financially unable to finance the engine installation and also wants to show an immediate cash saving and therefore does not want to pay for the engines out of the savings, arrangements could be made to rent the engines on the basis of a fair return, plus a small profit. In this way the consumer would show immediate cash profits, even though in the end his total net profits would not be so great as if he had purchased the engines. It is our opinion that this method would appeal to many who would not otherwise entertain the idea of using gas engines. It should be considered as a last resort, on desirable business only.

Analyzing Costs

Most of the competition in selling gas engines in Southern California comes from the advocates of electric motors. We regret to say that in making comparisons in difference of operating costs our electrical competitors have made many misleading statements as to the operating cost of a gas engine. The following analysis will help to establish the facts as regards these operating costs.

Cost of operation is based on two charges, namely:

(a) *Fixed Charges,* consisting of
1. Interest on the investment.
2. Depreciation.
3. Insurance.
4. Taxes.

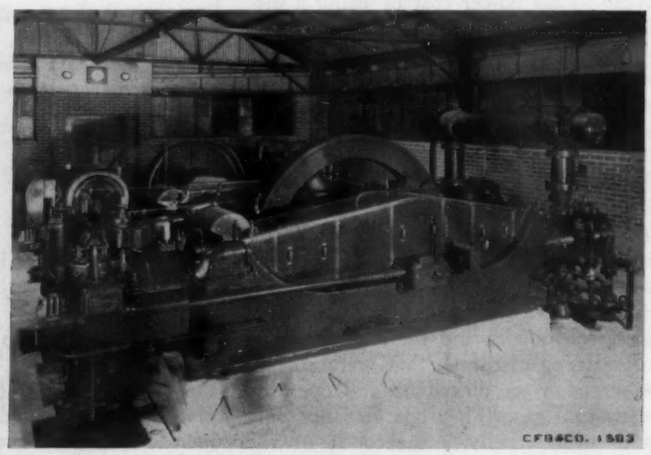
(b) *Operating Charges,* consisting of
1. Fuel.
2. Lubricating oil.
3. Repairs or maintenance.
4. Labor.

Taking each item separately, *Fixed Charges* may be analyzed as follows:

(1) *Interest:* Interest is charged to cover the capital tied up in the engine investment. This is justified by the consideration that if power could be purchased ready made, the capital could be loaned out or used in the business in such a way as to yield a return. Six per cent is the rate generally adopted for this item, although in many instances 5 per cent, and even less, is justified. Where the cost of the installation is paid for out of difference in operating costs —the saving between a gas engine and some other source of power—there would be no capital invested, and, consequently, there can be no interest charge.

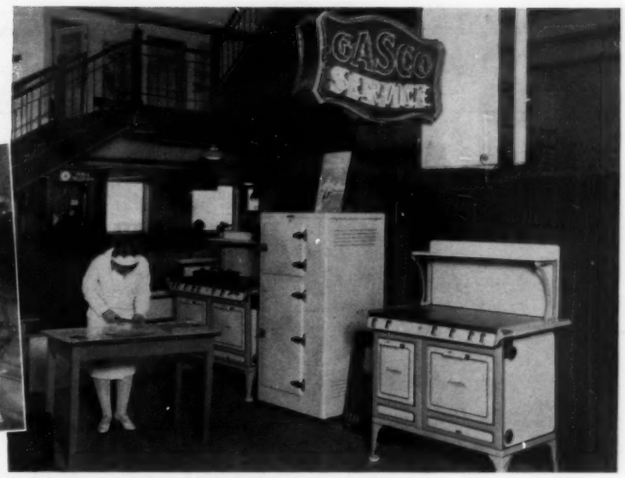
(2) *Depreciation:* Depreciation is a charge set aside to allow for the replacement of the engine when it has become worn out. In the bank account, the funds necessary to replace the gas engine are, of course, not segregated, but lumped together in a single account. It is therefore obvious that the depreciation account is a fiction. The common practice of assuming a certain number of years engine life and dividing the number of years determined on into the gas engine installation cost, is wrong, for the reason that this method does not take into consideration the interest

(Continued on Page 52)



LEFT: Crescent Creamery Co., Los Angeles; 4-120 h. p. gas engines operating ammonia compressor; 1-160 h. p. engine operating 125 KVA generator. RIGHT: 170 h. p. Type 80 Cooper gas engine, horizontal single acting 4-cycle twin-type, direct connected to 17 x 20 and 10 x 20 compressor cylinders. Operates up to 110 lbs., supplying air for all air tools in C. F. Braun & Co. plant, Alhambra, Calif.

AT RIGHT: *Exhibit booth of the Seattle Gas Co., maintained in the Security Market.* BELOW: *Model kitchen of the company on the balcony of the market.*



Home Service *in a* Public Market

HOW one gas company has solved the problem of limited space for maintaining permanent home service facilities is told by the success of the plan recently placed in operation by the Commercial Department of the Seattle Gas Co., Seattle, Wash. Adequate quarters were leased by the company in a new public market where thousands of housewives daily purchase their food supplies. "Miss Gasco" in the person of Miss Alice Gibbs, company home service director and her assistant, is in charge to demonstrate modern gas appliances, to give advice on menus, to help in the planning of parties and dinners and to conduct the cooking schools.

"GASCO" APPLIANCE BOOTH

A home service display and appliance booth occupies a space 10 feet by 20 feet on the ground floor, while a model kitchen is located on the balcony.

The appliance booth on the ground floor is chiefly a display of the latest and most modern gas fired equipment arranged in an attractive manner that never fails to attract the eye of the shopper. In a prominent place over the booth is a Neon sign heralding "Gasco Service" in letters of a size that "he who runs may read." The booth is in two sections, one showing kitchen appliances, the other representing a living room with a large mantle Radiantfire and a circulating heater. A gas fired furnace is also on display in this section. Comfortable chairs and a davenport are provided where shoppers may rest in front of the fireplace, and where "Miss Gasco" offers free recipes and invites inspection of the appliances.

The model kitchen on the balcony is equipped with two ranges, and an Electrolux gas refrigerator, a Welsbach Hot-Zone water heater and other appliances, and is provided with a public address system making it possible for the demonstrator to talk to a crowd of from 200 to 250 women at one time. This kitchen is the center of much interesting co-operative home service activity.

At 10 o'clock in the morning Station KOMO broadcasts the latest features of gas fired appliances, suggesting menus, recipes, and giving ideas to be used in the preparation of economical and tasty dishes.

Each day for the luncheon hour Miss Helen Malloy of the market in which the display is housed, in cooperation with distributors of food products, serves a luncheon to various groups of club women, usually accommodating about 75. After luncheon the guests inspect the gas appliances by means of which the meal was prepared, adjourning at 1:30 for bridge in another room in the market.

COOKING SCHOOLS

Three days a week, Monday, Wednesday and Friday, from 2:00 until 4:00 p. m., the Prudence Penny and Gasco cooking schools are held. Here again housewives are assisted in the planning of meals, preparation of economical dishes, and are given suggestions for family and party menus. An added feature of these schools is the raffling of prizes by advertisers in the market. It is estimated that an average of 250 women per day have a complete demonstration of gas fired appliances through the medium of this cooperative cooking school.

During the Christmas holidays, special demonstrations were held. Each drew a record attendance, hundreds of housewives seeking advice on the preparation of holiday dishes and suggestions for menus in keeping with the Christmas season.

Each month 500 sets of recipes and a letter telling of "Gasco" service are mailed to a selected list of prospects, obtained through the cooking school.

NEWSPAPER COOPERATION

The gas company maintains close cooperation with the daily newspapers. Seattle Post Intelligencer, through Prudence Penny, assists in sponsoring the thrice-weekly cooking schools, while the Seattle Times sponsors a free cooking school which is conducted by Ella Lehr of the Ella Lehr Cooking Schools, San Francisco. The first of these was held during 1930, and was so successful that a second is planned, to be held some time in the early Spring months. This school is held in a rented theater and is advertised through the medium of the newspaper, radio and "Gasco" booth. Approximately 3,000 attended during the four days of sessions held last year.

Another unique idea which the Seattle Gas Co. plans to work out during the early spring months, is the holding of Saturday morning cooking classes for school children. This series will also be sponsored partly by a Seattle paper.

The Home Service Department of the Seattle Gas Co. is comparatively young, but there is every evidence that it will soon become one of the most important operating units of the company. Miss Alice Gibbs, as home service director, is in charge of the department.

OWNER ADDRESS PREMISES USED FOR PHONE DATE

ROOM	DIMENSIONS IN FEET L.	W.	H.	CUBICAL CONTENT	AIR CHANGE	BTU. LOSS PER HOUR DUE TO AIR CHANGE	EXPOSURE	HEAT LOSS DUE TO RADIATION: LENGTH OF EXPOSED WALL	GROSS WALL AREA SQ. FT.	GLASS AREA SQ. FT.	NET WALL AREA SQ. FT.	FLOOR AREA IN SQ. FT.	CEILING AREA IN SQ. FT.	ROOF AREA IN SQ. FT.	RADIATION OR DUCT AREA INSTALLED: COL.	SEC.	HGT.	RAD.	BTU. LOSS PER HOUR
TOTAL																			

DESCRIPTION OF HOUSE TYPE OF HEATING PLANT MAKE RATING SIZE

WALL CONSTRUCTION FACTOR USED ( )

BASEMENT " " ( )

ROOF CONSTRUCTION " " ( )

IN VICKSBURG THE TEMPERATURE SO SELDOM FALLS BELOW 10° F. THAT THIS IS THE FIGURE USED IN HEATING WORK. THE AVERAGE INSIDE TEMPERATURE IS TAKEN AT 70° F. THE TEMPERATURE RISE TO BE CONSIDERED IS THEREFORE 60° F. THE HEATING INSTALLATION SHOULD BE OF SUFFICIENT SIZE TO RAISE THE TEMPERATURE FROM 10° F. TO 70° F. IN A REASONABLE LENGTH OF TIME AND TO KEEP IT AT THE LATTER FIGURE. REQUIREMENTS WILL THEN BE HOURLY BTU. LOSS DIVIDED BY 1000.....÷ 1000 =..... BTU. OF 1 CU. FT. OF NATURAL GAS IS 1000. THERE ARE VARIOUS LOSSES TO BE CONSIDERED, CHIEF OF WHICH ARE, LOSS IN HEATING PLANT, CHIMNEY, RISERS, LEADS, ETC. IN THIS CASE WE WILL USE A PERCENTAGE OF.....% FOR THE EFFICIENCY OF THE ENTIRE INSTALLATION. THE GAS REQUIREMENT WILL THEN BE .....÷.....=.....CU. FT. PER HOUR CAPACITY. GAS CONSUMPTION PRECEDING YEAR.....M. C. F. AMT. PAID.....

GAS HEATING WILL COST APPROXIMATELY $.....FOR HEATING SEASON AND ALTHOUGH THIS FIGURE CANNOT BE GUARANTEED FOR OBVIOUS REASONS, WE HOWEVER, BELIEVE IT TO BE A CONSERVATIVE ESTIMATE. HOURLY BTU. LOSS.....× FACTOR.....=.....

SEASONAL GAS CONSUMPTION. SEASONAL COST FOR GAS HEATING $.....

SURVEY MADE BY CHECKED BY

Vicksburg Gas Co., Vicksburg, Miss., has developed this form for estimating heating requirements. It is of standard letter head size, imprinted on both sides of one sheet

Recording Data *for* Househeating Sales

WELL designed forms for use in accumulating information needed by sales departments are an important factor in efficient organization. Particularly is this the case in recording househeating data, where facts on present heating installation, type of residence, requirements to be met by gas furnace or conversion unit, etc., must all be set forth for convenient reference.

The househeating department of the Vicksburg Gas Co., Vicksburg, Miss., has developed a form which is serving its purpose so excellently that it is reproduced on this page for the interest of *Western Gas* readers. It will be noted that it provides for a record of information on the heating job, and on other fuels and appliances in use, at the same time serving as an estimate sheet which can be submitted to the prospect. A cross-ruled portion is provided for sketching in special details of individual jobs.

LOCATION OF HEATING PLANT

LOCATION OF REGISTERS

LOCATION OF FURNACE VENT

SIZE OF ASH DOOR OPENING

DIAMETER OF FIRE BOX.....OR RECTANGULAR DIMENSIONS.....W.....D.

LENGTH OF 2 WIRE THERMOSTAT CABLE REQUIRED.....FT.

LENGTH OF 2 WIRE CURRENT SUPPLY FROM INDEPENDENT CIRCUIT.....FT.

VOLTAGE..... CYCLE..... TYPE OF LIMIT CONTROL.....

SIZE OF SERVICE..... LENGTH OF SERVICE FROM MAIN TO METER.....

SIZE OF METER..... HOURLY CONSUMPTION TOTAL CONNECTED LOAD.....

TYPE OF BURNER..... SIZE..... RATING..... INSTALLED COST $.....

TYPE OF THERMOSTAT..... MODEL NUMBER.....

LENGTH OF GAS PIPE FROM METER TO HEATING PLANT..... SIZE.....

REMARKS.

SPECIAL INSTRUCTIONS TO FITTERS

OTHER APPLIANCES & FUEL USED √

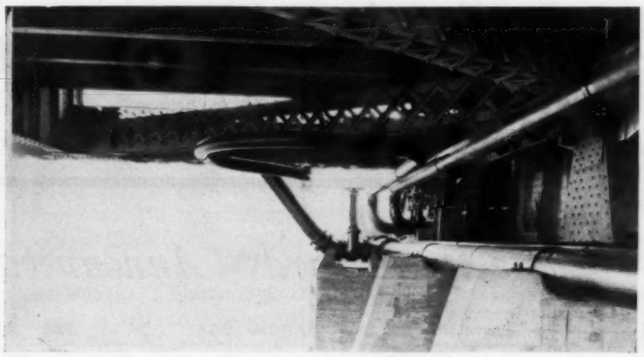
REFRIGERATOR HOT PLATE LAUNDRY STOVE

GAS RANGE ELECTRIC RANGE OIL STOVE SOLID FUEL STOVE

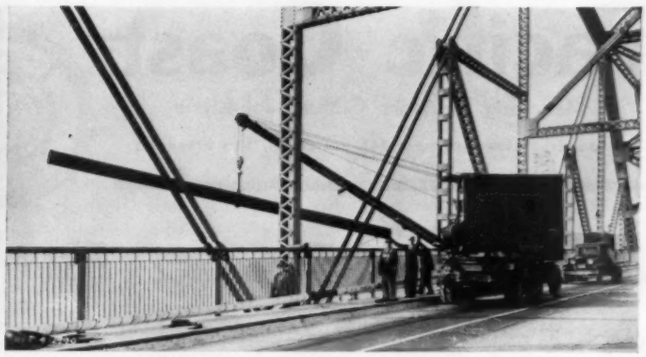
FURNACE COIL WATER HEATER SPACE HEATER INCINERATOR

PROSPECT FOR

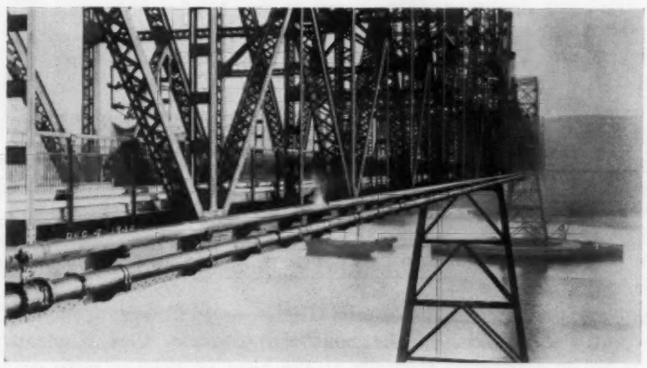
SKETCH



Looking up at one of the six expansion loops suspended beneath roadway of bridge. Line with the manually operated gate valve is a water main.



Lowering pipe over side into position on brackets for welding. Bridge was kept open for traffic at all times. Temporary 6-inch line can also be seen.



View showing a welder at work on the tie weld, Carquinez Straits crossing, P. G. and E. Co.'s North Bay Division. Note temporary rollers on brackets which enable pipe to be rotated.

View from north end of bridge, showing brackets fastened into position on channel iron above cast iron water main. Fitted saddles are oil impregnated wooden blocks.

Engineering *the* Carquinez Crossing

By A. E. ENGLEBRIGHT

Superintendent Gas Department, North Bay Division, Pacific Gas and Electric Company

IN the fall of 1930 the Pacific Gas and Electric Co. completed a natural gas line from the Standard Pacific line at Crockett to Petaluma, Sonoma County, Calif., a distance of 37 miles. This line branched into a north and south line feeding a territory from Sausalito on the south to Healdsburg on the north. In addition, taps were taken off this line to feed Vallejo in Solano County and Napa and the entire Napa Valley north to Calistoga. This territory makes up what is known as North Bay Division and embraces a total area in excess of 2000 square miles. Through this development natural gas has been brought to over 30,000 consumers.

The most interesting feature in connection with the construction of this line was the crossing of the Carquinez Bridge. A 16-inch line from Crockett to the south approach of the bridge carries gas at 200 pounds pressure and the whole system is designed with figures based on the maximum capacity of 10,000,000 cu. ft. per day.

The problem encountered in running the pipe line across a bridge the size of the nationally known Carquinez Highway Bridge presented some new features not often encountered in gas transmission engineering. The Carquinez Bridge, built a few years ago by the American Toll Bridge Company, is the longest highway bridge of the double cantilever type in the world. The total length of the bridge is 4482 feet, of which 3350 feet are covered by the main span, with 1132 feet of high viaduct. To provide for the expansion based on the temperature range of 32° to 110°F. two 6-inch and two 12-inch expansion joints are included in the structure. This provides a total expansion of 36 inches. In planning the pipe line it was necessary not only to provide for the proper total of expansion but to provide means whereby the greatest flexibility in the line would fall at the portions of the bridge where the normal bridge expansion is taken up. In addition, the bridge authorities insisted that two lines should be run, one on each side of the bridge, in order that the bridge balance might not be disturbed, as the total weight of the two gas lines and the two water lines is the equivalent of a continuous line of cars across the entire bridge.

The two 12-inch lines were constructed without a lost time accident of any kind despite most unfavorable working conditions. The hazards that attended the welding operation included working at a great height (135 feet above the waters of the strait) and in the face of an almost continuous gale that swept up the Carquinez Strait into

(Continued on Page 54)

Pacific Coast Gas Association

Managing Director: Clifford Johnstone

Association Headquarters: 447 Sutter St., San Francisco

President: R. E. Fisher

Vice-President, Pacific Gas and Electric Co., San Francisco

2284 Compete in 1931 Essay Contest; Awards Announced

ONCE more the annual Essay Contest of the Pacific Coast Gas Association has drawn to a successful close, with W. A. Hayward of the San Diego Consolidated Gas and Electric Co. awarded the first prize of $50, closely followed by George H. Logan of the Los Angeles Gas and Electric Corp., second prize of $30, and Fred Renz of the Westside Natural Gas Co., third prize of $20.

Additional prizes of $10 each were awarded the following 10, whose names have been arranged in alphabetical order, the judges feeling their essays were all equally good:

Fred R. Cadman, Seattle Gas Co.
T. Kerr, Southern Counties Gas Co.
Mary Kinerk, Southern Counties Gas Co.
R. B. Leavitt, Natural Gas Properties, Inc.
Fannie Loveless, Los Angeles Gas and Electric Corp.
Alice E. Paristia, Coast Caunties Gas and Electric Co.
George M. Sadler, Los Angeles Gas and Electric Corp.
J. D. Steen, Los Angeles Gas and Electric Corp.
Ethel W. Steigh, Southern California Gas Co.
E. J. Strickland, Southern California Gas Co.

Besides the above 13 awards on merit, 40 prizes of $5 each were awarded in the "grab-bag", in which all essays not otherwise winning a prize are entered, and 40 drawn by lot:

William R. Fyfe, Spokane Gas and Fuel Co.; Mary Kathryn Jarrett, Southern California Gas Co.; Arthur T. Sherman, San Joaquin Light and Power Co.; W. J. Watt, Coast Counties Gas and Electric Co.; A. R. Donnell, West Side Natural Gas Co.; Frank Morrow, James H. Lynch, Portland Gas and Coke Co.; Vern L. Simmerly, Washington Gas and Electric Co.; Art Dybdahl, Washington Gas and Electric Co.; Jerome Fee, Pacific Gas and Electric Co.; P. Le Brun, Elsie Carter, J. R. McDonald, Thomas Connors, Luke Suggett, Leon E. Ellison, P. F. Ditzler, B. A. Devine, W. H. Dooling, F. A. Miller, Dwight Higgins, John A. Cowdry, Earl I. Esan, H. B. Palmer, Jim Goldberg, Archie O. Worsham, Southern Counties Gas Co.; A. W. Constable, G. H. McConnell, George A. Stewart, E. L. Taylor, Melvin A. Green, Louis Leidel, John C. Enders, F. H. Lyon, Mrs. Evelyn Marsh, Charles H. Cook, E. B. Stoner, N. L. Jones, N. K. Senatoraff, Los Angeles Gas and Electric Corp.; Tom Batty, San Diego Consolidated Gas and Electric Co.

It is interesting to note that this year there was a total of 2294 essays, or an increase of 1070 over last year, which is equal to 88.1 per cent. The major portion of this gain must be attributed to the contest conducted between employees of the Los Angeles Gas and Electric Corp. and Southern Counties Gas Co., although substantial gains were shown by most of the other competing companies, as recorded in Table No. 1.

TABLE NO. 1. RESULTS OF PACIFIC COAST GAS ASSOCIATION ESSAY CONTEST FOR 1931

Name of Company	No. of Gas Employees	Essays 1930	Essays 1931	Pctg. 1930	Pctg. 1931
Arizona Edison Co.	48	1	1	1.4	1.4
Coast Counties Gas and Electric Co.	215	48	80	29.3	36.9
Los Angeles Gas and Electric Corp.	1884	693	963	34.5	51.1
Natural Gas Properties, Inc.	125	.....	31	.....	24.0
Pacific Gas and Electric Co.	2430	84	107	2.1	4.4
Portland Gas and Coke Co.	836	69	100	8.0	11.9
San Diego Consolidated Gas and Electric Co.	467	11	30	2.6	6.4
San Joaquin Light and Power Corp.	1406	.....	18	.....	1.28
Seattle Gas Co.	478	42	2	8.6	.5
Southern California Gas Co.	2094	39	68	1.9	3.2
Southern Counties Gas Co.	1213	188	826	15.1	68.1
Spokane Gas and Fuel Co.	111	7	13	6.8	11.7
Washington Gas and Electric Co.	104	31	34	17.9	32.7
West Side Natural Gas Co.		.....	11	.....	
TOTAL ESSAYS		*1224	2284		

*Including British Columbia Power and Gas, 6, and Northwest Cities Gas Co., 5, which entered no essays this year.

Three additional companies participated this year, which have not heretofore entered, namely Westside Natural Gas Company (which, by the way, boasts one of the three winners), Natural Gas Properties, Inc., and the San Joaquin Light and Power Company. The Southern Counties Gas Company stands at the head of the list with 68.1 per cent of its employees competing in the contest, followed by Los Angeles Gas and Electric Corp. with 51.1 per cent and Coast Counties Gas and Electric Co. with 36.9 per cent.

Judges for the contest this year included Elliott Taylor, James Knowland and Miss Jean Frickleton, all of whom are familiar with gas utility work, and yet are in no way connected with any of the utility companies which were participating.

Many Section Conferences Held in March

MARCH was a busy month for the Association's Section Chairmen and their co-workers. The month was devoted to mid-year conferences, the Technical Section leading off with a two-day session in Los Angeles on March 5 and 6, with General Chairman W. M. Henderson presiding. The program, which was fully reported on this page in March *Western Gas*, was put through with a thoroughness and interest that reflects great credit upon the members of the Section and promises that the Technical reports for 1931 will live up to the high standard set in previous years. The attendance at the Technical Conference was close to 200.

An equally successful Conference was held by the Accounting Section on March 13 and 14, under the leadership of General Chairman R. A. Hornby. The morning session on March 13 was devoted to a study of the classification of accounts for natural gas companies as written by the National Association of Railroad and Utilities Commissioners. E. N. Simmons of the Los Angeles Gas and Electric Corp. is chairman of the committee making this study. At noon the delegates attended a luncheon at the Jonathan Club, the speaker of the day being W. C. Mullendore, vice-president and general counsel of the Southern California Edison Co. In the afternoon R. W. Baily, construction and stores auditor of Southern California Gas Co.,

discussed the accounting problems occasioned by pipe line construction, illustrating his talk with motion pictures of such construction in progress. The second day was devoted to a review of opinion concerning the credit problem faced by utilities. This subject is being studied by a committee headed by O. L. Moore of the Los Angeles Gas and Electric Corp.

On March 25 the Northwest members of the Commercial Section gathered in Portland for an informal meeting and on March 26 and 27 the California members participated in a joint conference of the Commercial, Public Relations and Publicity and Advertising Sections held in Los Angeles. John H. Hartog, Sales Manager of the Portland Gas & Coke Co., acted as host to the Northern men and presided at the business sessions. Vice-President James L. Stone of Spokane addressed the meeting and presided at the closing dinner. F. U. Naylor of San Francisco attended the meeting as the personal representative of H. M. Crawford, General Chairman of the Commercial Section, who was attending the Los Angeles conference.

The joint conference in Los Angeles was devoted to a discussion of sales, advertising and public relations topics. H. M. Crawford, Commercial Section Chairman, presided at the morning session on the first day, which was devoted to a general review of the progress made by each Section and Commercial Section committee reports by A. P. Stryker and Chas. L. Ferry. A luncheon held in the L. A. Gas Building Auditorium was addressed by Addison B. Day, president of the Los Angeles Gas and Electric Corp., and W. C. Mullendore, vice-president, Southern California Edison Co. George L. Myers, General Chairman Public Relations Section, presided at the afternoon session, the program including addresses by A. B. Macbeth, president Southern California Gas Company; Dr. Gordon S. Watkins, Professor of Economics, University of California at Los Angeles, and James S. Knox, president of the Knox School of Salesmanship of Chicago. F. H. Holden described the advertising campaign in which the three Los Angeles companies are cooperating.

On the morning of the second day Walter D. Thurber, General Chairman of the Publicity and Advertising Section, led the session, introducing F. S. Wade, president of Southern Counties Gas Co., R. W. Miller, executive vice-president of Pacific Lighting Corp., and H. M. Crawford, general sales manager of Pacific Gas and Electric Co. At noon, adjournment was taken to attend a luncheon of the Los Angeles Advertising Club, the speaker of the day being J. Chas. Jordan, Chairman of the Association's Committee on Cooperative Advertising.

The afternoon was devoted to separate business sessions of the three Sections.

Good Return Reported on Cooperative Advertising

IN a bulletin issued March 16, the Committee on Cooperative Advertising makes a detail statement of letters received in February as a result of the weekly Gas Industry Broadcast. The total number of letters was 2,328, and it is interesting to note that 89.2 per cent of these came from the territory of company members of the Association. Of these 38 per cent came from northern California, 36 per cent from southern California, 16 per cent from Washington, and 10 per cent from Oregon. The ratio of gas customers in these same territorial subdivisions is 33, 52, 9 and 6 per cent respectively. During February, at least, the return was therefore relatively greater in the North than the South, due possibly to the greater percentage of indoor weather at this time of year.

Arizona Utilities Ready for April Meeting

THE next event on the P. C. G. A. calendar is the famous annual jamboree of the Arizona Utilities Association, to be held this year at the Arizona Biltmore, Phoenix. The Pacific Coast Gas Association will be officially represented by its president, R. E. Fisher, and unofficially by many another of its California and Arizona members.

After that the Northern Regional Conference of the Pacific Coast Gas Association in Tacoma, June 11 and 12.

Data Book on Gas Meets Popular Favor

THE Architects and Contractors Manual, otherwise known as the "Data Book on Gas Fuel," which came off the press late in February, has attracted wide attention and gives evidence of equaling the record of our "Gas Appliance Installation and Service Manual," which ran into five printings and achieved an international reputation. The book has already been distributed to architects in Los Angeles and special insert sheets are being prepared for several of our companies.

A secondary use of the book is developing, as a number of copies have been purchased for use by salesmen as reference books on domestic gas utilization.

Member companies of the Association have been supplied with full information on prices, special insert sheets, etc., and this information will be supplied to other companies upon request. All inquiries should be addressed to the Pacific Coast Gas Association, 447 Sutter Street, San Francisco, California. Orders for single copies should be accompanied by a check for $1.00.

New Gas Company Joins Association

The Western Gas Co. of Washington has become a company member of the Pacific Coast Gas Association. This company has erected a water gas plant in Longview, Wash., which is now in operation and has constructed a second plant to serve the City of Bremerton, Wash.

C. B. Shaklee has recently come from Salina, Kan., to Longview as general manager of the Western Gas Co. and will represent the company in the Pacific Coast Gas Association.

Southern Counties Remodels Compressor Plant at Santa Paula

Work on the remodeling and enlarging of the Southern Counties Gas Co.'s compressor station at Santa Paula, Calif., and its conversion to a main line booster station on the Los Angeles transmission line, has just been completed at a total cost of $21,100. The conversion of the compressor plant to a main line booster station has increased the daily capacity of the Los Angeles line by 4,000,000 cubic feet.

A peak day capacity was established on January 14 of this year when the Los Angeles line transported 36,518,000 cubic feet of natural gas, the highest amount recorded since the installation of the line.

New Line Provides Gas Service at Carpenteria

A new 12-inch natural gas distribution main tying in with the new 16-inch line from Elwood Field to Ventura, Calif., has just been completed along Foothill Road by the Southern Counties Gas Co., Los Angeles, Calif. It will provide gas service to a small section adjacent to Carpenteria.

A number of ranches will be served by the new main and have already installed gas equipment to utilize the fuel for cooking, house heating, water heating and refrigeration.

Memphis Program Nears Completion

WITH the dates of May 11-14 drawing closer, final program details are being arranged for the annual convention of the A.G.A. Natural Gas Department, assembling in Memphis, Tenn., convention sessions being held at Hotel Peabody.

Entertainment features give promise of an unusually fine demonstration of "Southern hospitality," and include an old fashioned Southern barbeque, grand ball, cabaret banquet, wrestling matches, theater parties luncheons, sight seeing and golf. Tickets for all special features will be issued to each delegate at the time of registration.

W. J. O'Brien
Chairman Arrangements Committee

Monday, May 11, will be given over to registration, sight seeing, and committee meetings with the annual dinner of the managing and advisory committees scheduled for 6:30 on that date.

General convention sessions will open at 9:30 on Tuesday morning, May 12, with a greeting from H. C. Cooper, chairman of the Natural Gas Department. The Very Reverend Israel H. Noe, dean of St. Mary's Cathedral of Memphis, will offer the invocation, followed by an address of welcome by the Hon. Watkins Overton, mayor of Memphis.

H. C. Cooper, Hope Natural Gas Co., Pittsburgh, Pa., will give his "Chairman's Address" at this session, and will be followed with an address by Alexander Forward, managing director of the American Gas Association.

The final feature for this meeting is a talk on "Selling Natural Gas" by B. H. Gardner, Columbia Gas and Electric Corp., Columbus, Ohio.

At 2:00 p.m., delegates will re-convene for an afternoon session, with addresses stressing the production and transmission features of the industry. The following subjects will be treated:

"Natural Gas Statistics—Their Value"—L. L. Dyer, Lone Star Gas Co., Dallas, Tex.

Wrinkles—H. J. Hoover, Cincinnati, Ohio.

"Safety in the Industry"—(Speaker not yet selected.)

"Our Main Technical and Research Committee"—H. D. Hancock, Henry L. Doherty & Co., New York, N. Y.

"Gas Measurement"—H. S. Bean, U. S. Bureau of Standards, Washington, D. C.

"Pipe Line Flow"—W. B. Berwald, U. S. Bureau of Mines, Bartlesville, Okla.

"Gas Well Deliveries"—E. L. Rawlins, U. S. Bureau of Mines, Bartlesville, Okla.

"Utilization Research and Gas for Cooling"—E. D. Milener, American Gas Association, New York, N. Y.

"Compression and Transmission of Natural Gas"—P. McDonald Biddison, Southern Natural Gas Corp., Birmingham, Ala.

The entire morning on Wednesday, May 13, will be given over to a discussion of drilling. Each speaker, following a prescribed outline for easy comparison, will give a presentation on the subject covering his section of the country. After the three presentations, the meeting will be open for a general discussion of drilling.

Drilling Symposium

For the East—J. French Robinson, Hope Natural Gas Co., Pittsburgh, Pa.

For the Mid-Continent—B. M. Howery, United Gas Public Service Co., Houston, Texas.

For the Pacific Coast—(Speaker not yet selected.)

Wednesday afternoon, at 2:00 o'clock, delegates will again assemble for a general session, with the following addresses scheduled:

"Natural Gas Fellowships"—J. B. Tonkin, Peoples Natural Gas Co., Pittsburgh, Pa.

"A Uniform Classification of Accounts"—E. N. Watkins, Arkansas Natural Gas Corp., Shreveport, La.

"Detection and Prevention of Distribution System Leakage"—J. A. Martin and L. B. Denning, Jr., Lone Star Gas Co., Dallas, Tex.

"Modernism in Distribution Design and Operation"—G. J. Heckendorn, Public Service Co., of Colo., Denver, Colo.

"The Origin of Dust and Its Elimination"—D. A. Sillers, Lone Star Gas Co., Dallas, Texas.

"Field Testing of Large Positive Meters"—John C. Diehl, Metric Metal Works, Erie, Pa.

A production symposium will be held Thursday morning at 9:30. The three speakers on the symposium will follow a prescribed outline and will deal with the subject for their sections of the country. The meeting will be open for a general discussion after the three presentations.

Production Symposium

For the East—S. W. Meals, Carnegie Natural Gas Co., Pittsburgh, Pa.

For the Mid-Continent—R. M. Stuntz, Cities Service Gas Co., Bartlesville, Okla.

For the Pacific Coast—(Speaker not yet selected.)

This will mark the final business session of the convention, which will be closed with reports from the Committee on the Chairman's Address and the Committee on Final Resolutions.

Committee chairmen in charge of convention arrangements include:

General Arangements Committee, W. J. O'Brien, Memphis, Tenn.

Hostess Committee, Mrs. W. D. Kyser and Mrs. W. J. O'Brien, co-chairmen.

Program Committee, E. F. Schmidt, Dallas Texas.

Publicity Committee, Paul Renshaw, Memphis, Tenn.

Hotels Committee, J. J. Brennan, Memphis, Tenn.

Reception Committee, W. N. Ford, Memphis, Tenn.

United Reports Active Progress on Texas Carrier

United Gas Public Service Co., operating arm of the United System of Houston, Texas, expected to complete its extension to Hallettsville, Texas, by April, with a short unit on the main line between the Giddings and LaGrange laterals yet to be completed. This line extends from the company's San Antonio-Austin carrier and will service Schulenberg, Elgin, Butler, Bastrop, Smithville, Giddings, LaGrange, Weimer and Hallettsville. Distribution system construction and meter installations are under way in several towns on the line.

Progress on the company's major transmission line from Kirbyville, Texas, to Franklin, La., has been retarded during March, owing to the rainy weather and character of the terrain. The line traverses swampy land for miles, and heavy rains were constant in March.

Construction to Start Soon on Colorado Springs Line

Bids for construction of Colorado Natural Gas Co.'s 200-mile line from the Hugoton fields in western Kansas to Colorado Springs, Colo., were scheduled to be opened late in March, with announcement of the successful bidder to follow shortly, according to Harry A. Galligan, secretary and general manager of the company. Arthur K. Lee is president with headquarters at Colorado Springs.

Distribution system betterments in Colorado Springs are being planned by the city. C. C. Eastham, assistant city engineer, has been conducting surveys to determine work needed, and plans to lay high presure mains at several points in the city.

H. V. Mathews Now With Northwest States Utilities

H. V. Mathews, manager of the Gas Development Co. at Baker, Mont., for the past two years, is now in the Great Falls office of the Northwest States Utilities Co., to act as state supervisor of pipe lines and gas fields for the company. He is succeeded at Baker by Harry Schroth, formerly field superintendent for the company, whose place in turn is being filled be R. H. Robinson of Midwest, Wyo.

Newberg Office Opened by Portland Gas & Coke Co.

Portland Gas & Coke Co., Portland, Ore., opened offices in Newberg, Ore., on March 17. C. L. Chase has been placed in charge of the new office, with E. I. Kelly as sales representative. The company plans to begin service of manufactured gas in Newberg shortly, a line being constructed to serve that town, and projected to Dundee, Dayton, Lafayette and McMinnville.

Application to Serve Mancos, Cortez and Dolores, Colo., Filed

Franchise applications have been filed in the towns of Mancos, Cortez and Dolores, Colo., by L. Sachs and Fred C. Hallar, said to be representing a Minneapolis, Minn., organization. Mr. Sachs stated that his company expects to build a natural gas transmission line to these cities from the Hallar gas field, situated between Mancos and Cortez.

Progress Being Made on Western Gas Co. Line

Rapid rate of progress being made by two construction crews working out of Deming and Jal, New Mexico, on the Western Gas Co.'s line to Douglas and Bisbee, Ariz., and Cananea, Mex., indicates that completion may come in June or July. Nearly 300 men will be at work on the project when two additional crews go into action.

Bechtel & Kayser of San Francisco are in charge of line construction, Stone & Webster of compressor stations, with Ford Bacon & Davis holding the general contract on the line.

Construction of the Naco-Cananea section of the carrier was begun in March, with 100 men employed on this division.

San Diego Consolidated Completes Line to Oceanside

San Diego Consolidated Gas and Electric Co., of San Diego, Calif., has recently completed construction of its transmission line from San Diego to Del Mar, Solano Beach, Cardiff, Encinitas, Leucadia, Carlsbad and Oceanside. Manufactured gas from the San Diego plant will be served in these towns. The line is 26 miles long and is the largest single gas main project yet undertaken by the company.

An extension is also proposed to serve Otay and San Ysidro, Calif., about 5 miles south of Chula Vista, present southern terminus of the company's lines. The new carrier will cost approximately $50,000, and will extend San Diego Consolidated's territory to the Mexican border.

New Sales Handbook By Ray-Glo Corp.

Ray-Glo Corp., Athens, Ohio, manufacturer of radiant-type gas heaters recently brought out a handbook for the use of the company's dealers, distributors and salesmen as well as public utility companies. The book is attractively gotten up in loose-leaf form with embossed cover, and contains indexed information under chapter headings as follows: Construction, Sales Section, Purchasing, Advertising and Sales Helps, Servicing. The book is fully illustrated with line cuts and two-color half-tones.

Montana Consolidated Gas Companies, Inc. Is New Organization

The Montana Consolidated Gas Companies, Inc., filed articles of incorporation on March 17, naming as directors and incorporators the following: John Wight and F. G. Huntington, both of Billings, and Everett A. Rice, G. C. Hoyt and T. P. Jones, all of Shelby. Great Falls has been designated as headquarters for the company.

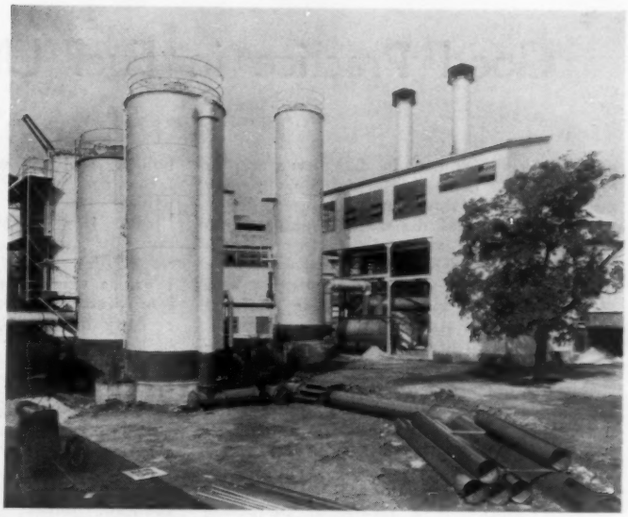
To Transfer Ely Franchise

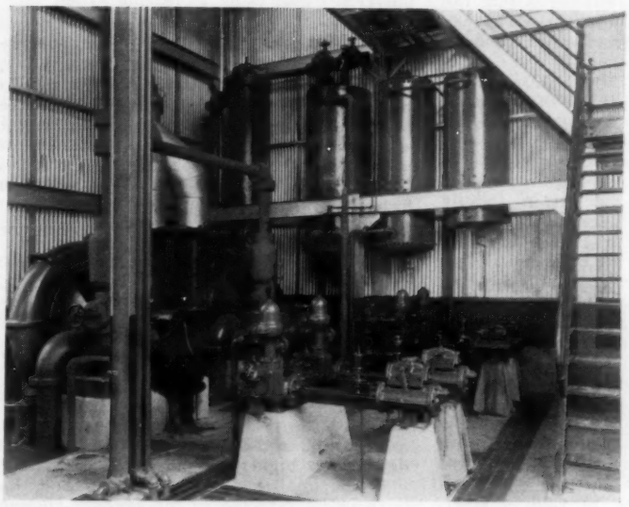
Mammoth Gas Co. has asked that the franchise recently applied for in Ely, Nev., be transferred to the Nevada Gas Co., a subsidiary.

Reports Gain in Gas Sales

Gas sales for Arizona Edison Co., of Phoenix, increased from 156,480,400 cu. ft. in 1929 to 167,229,800 cu. ft. in 1930, according to a report recently issued by the company.

AT RIGHT: General view of the new oil gas plant recently completed by the Honolulu Gas Company, Ltd., at Honolulu, T. H.





AT LEFT: Showing auxiliary apparatus in the 4,000,000 cu. ft. Jones oil gas set installed in the Honolulu plant.

Oil Gas Plant Addition at Honolulu

HONOLULU Gas Co., Ltd., Honolulu, Hawaii, has completed a new oil gas plant at the company's Iwilei location, under the direction and supervision of F. Q. Cannon, manager, and E. S. Jones, engineer.

The new plant, of 4,000,000 cubic foot daily capacity, includes a main building and complete auxiliary apparatus, and is situated across the yard from the old plant where two 2,000,000 cu. ft. oil gas sets have been in operation for many years.

The generator embodies many new features, and is installed for the addition of filter producers with which lampblack by-product is eliminated.

The control of the apparatus is completely automatic. The automatic control nest, on which is mounted the instrument panel, and the operator's desk occupy the operating floor directly in front of the set. On the instrument panel are mounted air, oil and steam gauges and meters and switchboard lights indicating the position of all remote control valves.

On the operator's table is an indicating pyrometer with selective switch. Operating mechanism and oil and steam headers and control valves are located below the automatic on the mezzanine floor. On the main floor all auxiliary apparatus is located in duplicate.

Ideal climatic conditions permitted the use of an open type of building with ample windows and open grating for all floors and stairs.

The plant was designed and constructed by Jones Gas Process Corp. of San Francisco, Calif.

Lewistown Natural Gas Co. Gets Lewistown Franchise

Lewistown Natural Gas Co., Lewistown, Mont., on March 2 was granted a franchise for the service of natural gas in that town. The company plans construction of a natural gas transmission line from the Armells structure in Judith basin, some 25 or 30 miles northeast of the town.

Drilling for Gas at Vale

United Utilites Corp., Minneapolis, Minn., began drilling operations near Vale, Ore., with gas as its objective.

Good Practice in Fuel Utilization

(Continued from Page 28)

ciencies as the stoker, in fact, even higher on jobs where the stoker is not given proper attention. And this condition often exists, as the purchaser of the stoker usually thinks that he can substitute the janitor for the fireman and leave the boiler room locked up most of the time. As a matter of fact, the stoker should be given reasonable attention in order to maintain the proper condition of fuel bed, discharge ashes, and keep the hopper filled.

But the other side of this picture is that few good firemen are found in these small plants and the stoker is a means of tempering combustion crimes which would otherwise be perpetrated by the man handling the plant. For such conditions, the stoker very properly represents a means of increasing firing efficiency, but the most important result of the average stoker installation is that the plant usually is able to purchase a cheaper grade of coal than had previously been fired by hand.

Either commercial fuel oil or the so-called light fuel oil can be fired in these plants. The former will run about 145,000 B.t.u. per gallon and when these plants are low-pressure steam this oil is best fired by means of feeding through a hollow shaft into a cup rotating at high speed and driven directly by a motor or by an air turbine taking air from a motor blower unit. This oil requires heating, usually by steam, before handling between tank and burner. Only a semi-automatic control on the high-low principle is feasible, as it is not good practice to use any form of pilot with this heavy oil.

The light fuel oil, referred to previously, can be fired in the standard type of heavy fuel oil burner or in the automatic light fuel oil motor-blower type of burner referred to under house heating. This oil, while costing more than the commercial fuel oil, is more satisfactory in many of these plants as it does not require heating in cold weather. Efficiencies in these oil fired plants generally range from 40 per cent to 65 per cent.

Gas firing equipment for these plants can be installed for automatic control from temperature or steam pressure, or on a high-low arrangement, or by hand adjustment. Efficiencies produced by the automatic jobs, while subject to less wide variation, are still very materially affected by the manner in which the actual firing controls are adjusted. The hand fired plants, as in the case of those fired by coal, are very much at the mercy of the janitor or the fireman, and as already stated, these small plants can hardly be expected to produce the higher class of fireman. With these factors in mind, the gas firing efficiencies will generally range from 40 per cent to 65 per cent.

Combining the three fuels, the following ratios can be suggested as good average practice for this small plant field:

16,000 cu. ft. gas per ton bituminous screenings.
18,000 cu. ft. gas per ton semi-anthracite screenings.
20,000 cu. ft. gas per ton mine run or nut bituminous coal.
140 to 145 cu. ft. gas per gallon oil.

High Pressure Boilers

In the third or high pressure boiler field should be considered horizontal return tubular boilers rated say from 100 to 200 boiler horsepower, the larger size Scotch-marine boilers, and all water tube boilers, which latter are usually larger than 200 horsepower.

Coal is fired by hand under the great majority of horizontal return tubular and the smaller sizes of water tube boilers. However, as was pointed out in the case of the low pressure commercial boiler, there has recently been quite an extensive application of the small stoker to these boilers. Most of these stokers require a pit to accommodate the more commonly used front feed sloping grate type of design.

It is hardly necessary to describe the coal stokers used under most water tube boilers. These stokers are generally of the underfeed or chain grate type and arranged for induced, forced, or natural draft. The larger modern coal burning plants are using pulverized coal to an increasing extent.

In these high pressure plants the common fuel is bituminous screenings, although many plants fire semi-anthracite screenings or slack. On stokers hardly any other size of coal is fired. On hand fired grates, considerable mine run is fired, mostly bituminous, as the semi-anthracite mine run to a greater extent undergoes screening preparation at the mines in order to produce the lump coal for house heating.

Good average heating values for these coals might be given as follows:

9,500 to 11,000 B.t.u. for bituminous screenings.
10,500 to 12,000 B.t.u. for semi-anthracite screenings.
11,000 to 13,000 B.t.u. for bituminous mine run.
12,500 to 14,000 B.t.u. for semi-anthracite mine run.

The high pressure steam plant naturally develops a higher average type of fireman than the smaller commercial plant and this is therefore reflected in the average efficiencies secured. In these larger plants, one result of the higher caliber of firing is that the efficiencies show small variation as between screenings or the mine run grades. Also the difference between bituminous and semi-anthracite efficiencies is small except in special cases. In other words, where there are vital reasons for making distinctions as between the bituminous and the higher carbon coals for domestic heating these reasons practically disappear in the large plant. These factors simplify the manner of comparisons and a good average range of efficiencies might be given as follows:

40% to 60% for hand fired plants.
45% to 70% on stoker fired plants.
60% to 80% on pulverized coal fired plants.

When air heaters and economizers are installed beyond the boilers, the efficiency figures usually cover the entire group. Where this is the case, care should be taken to split the efficiency down to the boiler and superheater only, and it is on this basis that the present efficiency figures are given.

Only heavy or commercial fuel oils are fired in these plants, these oils being either straight run fuel oils or the residuum from cracking plants. While all these fuels will average not less than 145,000 B.t.u. per gallon, the residuum is not as easy a fuel to handle as the straight run fuel oil. Either steam or mechanical atomizing oil burners are used.

Efficiencies on oil are probably best outlined under the following two broad groups:

60% to 77% for the smaller plants, compris ing mostly horizontal return boilers.
65% to 80% for the great bulk of water tube boiler plants.

In firing gas either high or low pressure types can be used and each type has its particular advantages and disadvantages. The efficiencies on gas for the same plant types outlined just above will average:

58% to 75% for the smaller plant.
63% to 78% for the larger plant.

Good average ratios for these fuels in the high pressure plants might be given as follows:

15,000 to 19,000 cu. ft. gas per ton coal in the smaller hand fired plants.
16,000 to 21,000 cu. ft. gas per ton coal in the larger stoker fired plants.
135 to 145 cu. ft. gas per gallon fuel oil.

The ranges indicated should be considered to refer to the lower grade screenings on the lower end and to the higher grade mine run coals on the higher end, that is, the variation is due primarily to differences in heating value of the grades of coal fired.

In these high pressure plants, the various boiler and furnace designs permit the use of numerous baffle and burner arrangements and it cannot be stated too strongly that the ultimate plant efficiency is influenced as much by the skill used in making the installation as by the choice of burner. However, all these factors lead to entirely too much detail to be considered here.

Another factor to be mentioned is that in burning natural gas the stack losses are 3 or 4 per cent greater than for fuel oil, all other operating conditions remaining the same, due to the greater per cent of hydrogen in the gas. This difference, however, is partially, and in many cases entirely, offset by the steam required for heating, pumping, and firing the oil. In the smaller plants where comparative results are necessarily more approximate, this theoretical factor has not been considered, but in the more carefully operated high pressure plants this difference in efficiencies must be considered.

In using the foregoing data, it must be remembered that all such comparisons are at best only approximate. The figures given are based entirely on a good many years of practical experience with all fuels, and not on theoretical desk calculations, and the ranges indicated cover generally a safe middle ground. Naturally, many comparisons will fall outside these figures, and some districts may very possibly come closer to either the lower or upper limits of the ranges given. These figures merely represent an attempt to give the man lost in the middle of a maze of fuel calculations a good safe middle ground from which to start. The principal lesson to draw is that such data represent merely a starting point, rather than a set of ironclad rules, and require the addition of copious quantities of experience, good judgment, and last but most important, good old common horse sense.

"Western Gas" Wants May, 1930, and Jan. 1931, Copies

Western Gas will pay 40 cents per copy for available copies of the January, 1931 and the May, 1930, issues. Please mail to the publication office, 124 West Fourth Street, Los Angeles, Calif.

1931 Calendar

April

American Chemical Society—81st Annual Meeting, Indianapolis, Ind., March 30 to April 3.

American Gas Association Distribution Conference—St. Nicholas Plaza Hotel, Cincinnati, Ohio, April 8-10, 1931.

Mid-West Gas Association—Annual Convention, Dubuque, Iowa, April 13-15, 1931.

Arizona Utilites Association (jointly with P.C.G.A. and P.C.E.A.)—Annual Convention, Phoenix, Ariz., April 9-11, 1931.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 16-18, 1931.

Annual Southwestern Gas Measurement Short Course—Norman, Okla., April 21-23, 1931.

Southern California Meter Association—Los Angeles, Calif., April 23, 1931.

American Gas Association Accounting Section Conference—Hotel Stevens Chicago, Ill., April 23-24, 1931.

May

Natural Gas Department, A.G.A.—Annual Convention, Memphis, Tenn., May 11-14, 1931.

Joint Production and Chemical Conference, A.G.A.—Benjamin Franklin Hotel, Philadelphia, Pa. May 20-22, 1931.

June

American Gas Association, Domestic Appliance Course—Testing Laboratory, Cleveland, Ohio, June 15-20, 1931.

P.C.G.A., Northern Regional Conference—Tacoma, Wash., June, 1931.

Canadian Gas Association—24th Annual Convention, Windsor Hotel, Montreal, Province of Quebec, Canada, June 4-5, 1931.

September

Pacific Coast Gas Association—Annual Convention, San Francisco, Calif., September, 1931.

October

American Gas Association—13th Annual Convention, Atlantic City, week of October 12, 1931.

Files Petition to Take Pipe Line Into Illinois

A hearing is scheduled to come before the Illinois Commerce Commission on April 8 on the petition filed by the Panhandle Illinois Pipe Line Co., affiliated with the Panhandle Eastern Pipe Line Co., asking for permission to construct a natural gas transmission line within the state borders.

Chester Guthrie to Manage at Shamrock

Chester Guthrie has been named as manager of the West Texas Utilities Co., at Shamrock, Texas, taking the post left vacant by H. G. Liston.

Butte-Anaconda Line Now in Sight

MONTANA POWER CO., and the Anaconda Copper Mining Co., have signed contracts with Louis B. O'Neil calling for delivery of natural gas to Butte, Anaconda, and a number of other Montana centers. Formation of the Northwest Gas and Transport Co., has been announced by Mr. O'Neil to drill some 20 wells in the Cut Bank area of northern Montana and to lay a 250-mile pipe line from these fields to points of consumption. The project involves from 10 to 12 million dollars in cost.

Crossing the main range of the Rocky Mountains at a point west of Great Falls the line may supply Helena enroute. It will bring gas to the Anaconda Copper Mining smelter at Anaconda, to the Butte mines of the same company, and to the domestic markets served by Montana Power Co. This company now holds franchises in Bozeman, Livingston and Deer Lodge in addition to Butte and Anaconda.

Pipe line construction will begin as soon as weather permits, according to Mr. O'Neil. The main line will be 20-inch or larger. Construction will be in charge of H. M. Parmelee.

Contracts call for 10 billion cubic feet of gas per year. Completion of the line is scheduled for Jan. 1, 1932. The main line from Cut Bank to Butte will be 230 miles long.

It is reported that the gas distribution system for Butte will cost $1,500,000 and that in Anaconda, $500,000. Compressor station facilities for the new line will call for a $1,000,000 outlay.

Associated with Mr. O'Neil in the Northwest Gas and Transport Co., are G. S. Frary, attorney, G. N. McCabe, land engineer, and H. W. Parmelee, engineer in charge of construction.

Celebrate Completion of Gas Line to Kent, Wash.

On March 9, the merchants of Kent, Wash., a thriving community of 2,500 people 15 miles south of Seattle, declared a holiday to celebrate the completion of 9 miles of gas main extension by the Seattle Gas Co., Seattle, Wash. At 2:30 in the afternoon interested spectators gathered to witness the official turning on of gas service by R. W. Murkar, mayor of Kent. In the evening Seattle Gas Co., was host to 125 citizens of Kent at a dinner. Addresses were given by James F. Pollard, general manager, J. Earl Jones, commercial manager, J. S. Holt, general superintendent, Mayor Murkar and Harvey Shaffer, president of the Kent Commercial Club.

Arkansas Western Announces 10 Per Cent Rate Reduction

Arkansas Western Gas Co., subsidiary of Southern Union Gas Co. of Dallas, Texas, announced a 10 per cent reduction in gas rates throughout its system, effective with the March bills. The company maintains headquarters at Fayetteville, Ark., serving in addition, Bentonville, Gentry, Siloam Springs, Rogers, and Springdale.

Recommend that West Virginia Build Distribution System

Property owners in West Virginia, Minn., recently petitioned the municipal department of Virginia, Minn., to extend its gas service to that town. Following a meeting of officials of the department, it was recommended that citizens of West Virginia form a company for distribution of gas in the town.

Central States Electric to Serve Belmond, Garner and Britt

Central States Electric Co., is constructing natural gas distribution systems in Belmond, Garner and Britt, Iowa. The company is a subsidiary of Iowa Railway & Light Corp., headquartered at Cedar Rapids. Franchises have been asked by Central States in Lovila, Bussey and Milo, Iowa.

Open House Held By Ottawa, Kan., Utility

The Union Public Service Co., Gas Service subsidiary, held open house on March 5 at Ottawa, Kan., at which time the company's new line of appliances was on display. J. W. King is manager of the Ottawa office for the company.

Neoga and Sigel, Ill., Preparing For Natural Gas Service

Distribution systems were expected to be under construction in March, preparatory to supplying the towns of Neoga and Sigel, Ill., with natural gas from the mains of the Panhandle-Eastern Pipe Line Co.'s main carrier.

$2,271,060 Construction Budget for San Diego Consolidated

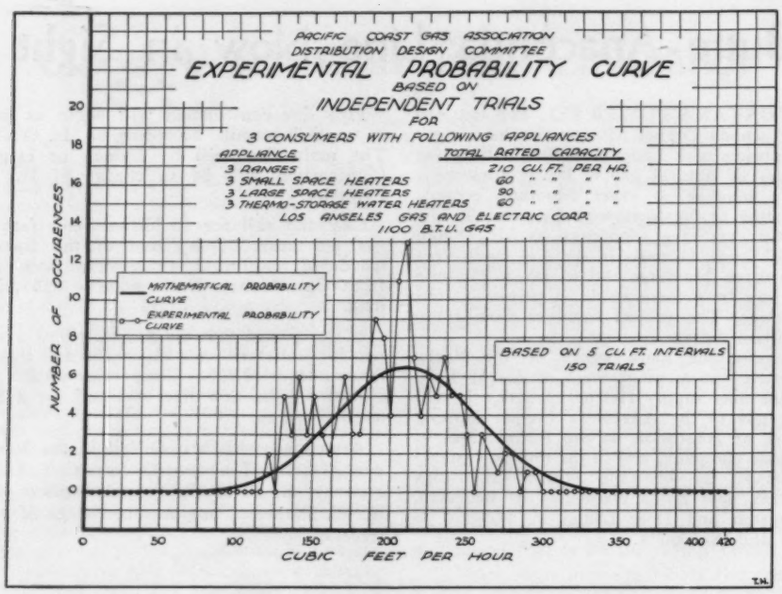
San Diego Consolidated Gas and Electric Co., San Diego, Calif., has been alloted a construction budget of $2,271,060 for 1931. The company is a subsidiary of Standard Gas and Electric Co., controlled by Byllesby Engineering and Management Corp.

Complete Extensions to Two Missouri Communities

Cities Service Gas Co., Bartlesville, Okla., in March announced completion of extensions to serve LaMonte and Emma, Mo. Emma will be served from the company's main line extension to Sweet Springs, while LaMonte will have its supply from the Sedalia main line. Work on the extension from Knob Noster to Windsor was expected to be complete sometime during the month. This line will also serve Green Ridge. Ozark Distributing Co., Gas Service Co., subsidiary, will serve these towns.

Chetopa Permit to Wackerle

H. E. Wackerle of Chetopa, Kan., was recently granted a franchise for the service of natural gas in Chetopa.


PACIFIC COAST GAS ASSOCIATION
DISTRIBUTION DESIGN COMMITTEE
EXPERIMENTAL PROBABILITY CURVE
BASED ON
INDEPENDENT TRIALS
FOR
3 CONSUMERS WITH FOLLOWING APPLIANCES
APPLIANCE
TOTAL RATED CAPACITY
3 RANGES 210 CU. FT. PER HR.
3 SMALL SPACE HEATERS 60 " " " "
3 LARGE SPACE HEATERS 90 " " " "
3 THERMO-STORAGE WATER HEATERS 60 " " " "
LOS ANGELES GAS AND ELECTRIC CORP.
1100 B.T.U. GAS
MATHEMATICAL PROBABILITY CURVE
EXPERIMENTAL PROBABILITY CURVE
BASED ON 5 CU. FT. INTERVALS
150 TRIALS
NUMBER OF OCCURRENCES
CUBIC FEET PER HOUR
0 50 100 150 200 250 300 350 400 420
0 2 4 6 8 10 12 14 16 18 20
T.M.

Graph VI

Gambling on Distribution Design

(Continued from Page 26)

fact that some consumers are easier to please than others has no bearing on this question because we are trying to please everyone, not just the tolerant few. In order to do that we are compelled to set the degree of certainty or, as it has been called, "The Diversity Odds," at a rather high figure.

The author ventures to say that 0.999 of certainty or "The Diversity Odds" of 1/1000 is a figure generous enough to satisfy the most recalcitrant of our consumers and one which certainly sets a service standard of extraordinary merit. Even this high standard permits the use of diversity factors which were heretofore undreamed of except by the most courageous distribution engineers.

Having established the degree of certainty at 0.999 the question still remains, "How does this apply to the probability curves?" Referring to Graph 3, we start at the rated connected load and sum the ordinate values downward until the sum reaches 0.001. Note that a decimal probability may be obtained by dividing the ordinate values expressed in chances into the total number of chances. Note also that if it were so desired the ordinate values beginning at zero could just as well have been summed upward until the sum reached 0.999. Assume for illustration that this happened at 480 cubic feet per hour. Then if the pipe which is to be designed has sufficient capacity to supply 480 cubic feet per hour at a pressure loss not exceeding the maximum established by law, we are living up to our standard of service and at the same time, we are effecting considerable economy by designing for 480 cubic feet instead of the full 660 cubic feet.

All of the foregoing remarks have been presented with one thought in mind, namely, to dispel some of the mystery surrounding mathematical probability curves and their application to problems in distribution design. It was not the intention to present any conclusions but rather to leave that to the Distribution Design Committee of the Pacific Coast Gas Association. From the foregoing, however, it will be evident that it does not require a skilled mathematician to apply the laws of probability to the gas business. From a practical standpoint the experimental probability curves are every bit as useful as the mathematical.

The moral of all this is, "Leave the dice alone and gamble on diversity—you can't lose."

Southern Counties Installation at Ventura School for Girls

Southern Counties Gas Co., headquartered at Los Angeles, Calif., recently completed the replacing of old model gas ranges with 14 new Vulcan restaurant-type ranges at Ventura State School for Girls, Ventura, Calif.

The institution is operated on the individual unit plan and includes 10 large separate residences, all of which have their own kitchens, dining room, reading and lounge rooms. The new ranges have been installed in seven of the residences in combinations of two, one open top and one closed top.

Other gas equipment in use at the school includes automatic low pressure gas steam boilers for all house and water heating purposes.

Irma, Alberta, in Line For Natural Service

A natural gas franchise was granted in March to Dave Credille and H. B. Armstrong in Irma, Alberta. Supply will come from wells near the town where a drilling program is under way. Work on the transmission line and distribution system was expected to begin as soon as an adequate supply of gas assured.

60,000,000 c. f. Gasser

Simms Oil Co. recently brought in a 60,000,000 cubic foot gasser in Bee County, Texas.

American Chemical Society in 81st Annual Meeting

The 81st meeting of the American Chemical Society is being held March 30 to April 3 in the Claypool Hotel at Indianapolis, Ind.

Special sessions are being held on Tuesday afternoon and Wednesday morning, April 1 and 2, by the Division of Gas and Fuel Chemistry, of which O. O. Malleis of Pittsburgh, Pa., is secretary.

Among papers to be given at these two sessions are the following: "Analysis of Light Oils from Low—and Intermediate-Temperature Carbonizations," by E. B. Kester and C. R. Holmes; "Effect of Properties of Petroleum Wash Oil in Removal of Light Oil from Coke Oven Gas", by H. R. Mathias; "Determination of Olefin, Aromatic and Paraffin Hydrocarbons in the Neutral Oil from Coal Tar", by E. B. Kester and W. H. Pohle"; "The Bromine Effect for Total Sulphur in Gas," by D. J. Demorest; "Studies in Adiabatic Calorimetry", by S. W. Parr and W. D. Staley; "The Flame Temperatures of Mixtures of Methane-Acetylene, Methane-Hydrogen and Methane-Oxygen with Air."

The Divisions of Gas and Fuel Chemistry, Industrial and Engineering Chemistry and Petroleum Chemistry are also holding a joint symposium on "Utilization of Gaseous Hydrocarbons."

Continental Construction Co.'s Line Complete to Missouri River

Six hundred miles of the Continental Construction Co.'s 950-mile line from Texas to Chicago had been completed by the middle of March, taking the carrier to the Missouri River crossing near Plattsmouth, Neb. Six compressor plants were in the last stages of construction late in March in Carson County, Texas; Beaver County, Okla.; Gage County, Neb.; and in Ford, Barton and Cloud Counties, Neb. Contracts were scheduled to be let sometime in March on three other stations, according to report.

Continental Construction Co., headquartered in Kansas City, was accepting bids late in March on the last unit of the line, to take it from Muscatine, Iowa, to Joliet, Ill., where the line ties in with the Insull system. Completion is expected by the first of June on this unit of the line if weather conditions permit.

New Dissertations Announced by Johns-Hopkins

The Johns-Hopkins University of Baltimore, Md., on March 1, announced the publication of two dissertations of interest to the gas and fuel industries—"An Investigation of the Manufacture of Water Gas with Especial Reference to the Decomposition of Steam," by Dr. Lloyd Logan; and "A Study of the Removal of Hydrogen Sulphide from Gas by Means of Iron Oxide with Special Reference to Humidity Conditions." Copies may be obtained by writing to Wilbert J. Huff, professor of gas engineering at the university.

New Advertising Program by Roberts-Gordon Appliance Co.

Roberts-Gordon Appliance Corp., Buffalo, N. Y., has announced a new advertising program, explained in its 1931 sales campaign book. The new publication outlines the procedure for the campaign, tells how to secure prospects, how to close them, what advertising to use and when to use it, shows the direct mail pieces, newspaper mats and folders which the company is prepared to furnish.

Oklahoma Utilities Convention Has Strong Gas Division Program

By CRAIG ESPY
Eastern Manager, Western Gas

IN keeping with the prevailing trend toward economy in industry, the Oklahoma Utilities Association shortened its 13th Annual Convention, held in Oklahoma City, March 10 and 11, by a day, and eliminated all features that could be dispensed with without impairing the practical value of the convention to the industry.

The major entertainment features such as the annual reception and dance and the annual banquet were removed from the program; and general session programs gave way to Divisional meetings in the realization that most profit could be had by each delegate from the departmental discussions of specialized problems.

As a result, Divisional meetings were marked by excellent attendance. Stronger and more valuable papers also resulted from this concentration on the Divisional meetings, as under this plan, speakers who would have formerly addressed the general sessions appeared on the Divisional programs.

Approximately 700 delegates registered at this year's meeting. While this figure falls somewhat short of registrations attained in recent years, it yet marks a splendid turnout, according to executives of the Association, in view of reduced budgets now in operation in many of the member companies.

The convention was opened on the morning of the 10th, with the one general session of the program. At this introductory meeting delegates representing each Division of the Association's activities, appeared on the program for an address.

The Gas Division was represented by James F. Orr of Houston, who in turn represented N. C. McGowen, vice-president of the American Gas Association. Mr. Orr's address was entitled "The National Gas Situation." He was introduced to the assembly by J. W. Duvall of the Oklahoma Natural Gas Corp., this year's chairman of the Gas Division.

An innovation in the general session program was the awarding of the McCarter medal of the American Gas Association to W. A. Beam, chief engineer of the Red Bird Compressor station of the Oklahoma Natural Gas Corp. The medal which was awarded Mr. Beam for the saving of human life, was formally presented the winner by E. C. Deal, president of the Oklahoma Natural gas Corp. This is the first time that the McCarter medal has been won by an Oklahoman.

Gas Divisional meetings, utilizing three half-day periods, were conducted under the chairmanship of J. W. Duvall, who was re-elected in the closing sessions to succeed himself as this year's chairman. Mr. Duvall had held the post for only a short period prior to the Convention, having been appointed to fill a vacancy.

Those appearing on the Gas Division program were Dean J. H. Felgar, of the University of Oklahoma School of Engineering, whose remarks dealt with the Southwestern Gas Measurement Short Course conducted each year at the University of Oklahoma; H. J. Hoover, Cincinnati, Ohio, editor of "Natural Gas," who spoke on "Natural Gas Progress in 1930; A. W. Breeland, safety supervisor of the Lone Star Gas Co., Dallas, spoke on "Accident Prevention in the Gas Industry"; and E. C. Cortelyou, of the production department of the Cities Service Gas Co., Bartlesville, read a paper entitled, "New Methods of Determining Open Flow Capacities of Gas Wells."

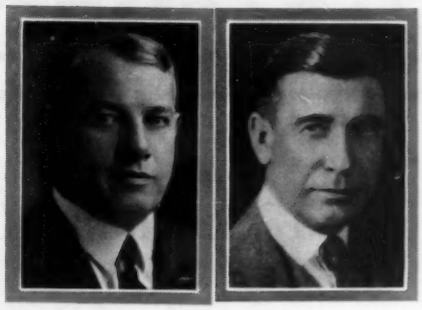
In the second Gas Divisional meeting, A. J. Schlosser, general superintendent of the Gasoline Department, Barnsdall Oil Co., Tulsa, spoke on the subject, "The Gas Engine in Industry." Considerable discussion followed the reading of this paper, and it appeared to be the concensus of opinion that rate structures should be created making it possible to more effectively build the gas engine load.

S. A. Lipscombe, new business manager, Arkansas Division of the Arkansas Natural Gas Corp., discussed "Organizing for Effective Appliance Installations and Services." Following this was a motion picture and discission of "Carbon Monoxide, the Unseen Danger," and "Carbon Monoxide Poisoning," led by G. T. Donceel, Oklahoma City, Industrial Sales Department of the Oklahoma Natural Gas Corp.

In the last session of the Convention, H. A. Atwater, chief engineer of the Combustion Equipment Co., of Kansas City, read a paper on "Good Practice in Utilization of Fuels." Following this paper T. W. Legatski, assistant director of research for the Philfuels Company of Bartlesville, read a paper, to have been delivered by O. M. Setrum, manager of the Philfuels Co. manufacturing division, Detroit, on the subject "Utilization of Liquefied Petroleum Gases by the Utilities."

James F. Orr, commercial manager, United Gas System, Houston, appeared on the program under the heading "Analyzing and Securing the Most Profitable Load." The last feature of the Gas Division program was a motion picture, "Building an Empire," presented by George H. Baird, general superintendent, Cities Service Gas Co., Bartlesville.

Committeemen who assisted in framing the program for the Gas Division meetings were, the chairman of the Division, J. W. Duvall, D. S. Foster, Cities Service Gas Co.; A. G. Dibbens, Guthrie Gas Co.; E. C. Joullian, Consolidated Gas Utilities; R. H. Luskey of the Corporation Commission of the State of Oklahoma; C. D. Reasor, Winchester Oil, Gas & Fuel Co.; E. W. Shull, Southwestern Light & Power Co.; and E. J. Driscoll, Central States Power & Light Corp.



J. W. Duvall
Re-elected Chairman Gas Division

H. L. Montgomery
2nd Vice-Pres., Representing Gas Division

In the election of officers to serve the Association during the coming year, E. F. McKay, for many years directing the excellent work of the Association, was re-elected as manager. H. L. Montgomery, manager of Cities Service Gas Co., Bartlesville, was elected as second vice-president, representing the Gas Division. Mr. Montgomery is also a director of the Association.

S. I. McElhoes, vice-president of the Southwestern Light & Power Co. of Oklahoma City, is the Association's new president, with R. J. Benzel, general manager of the Southwestern Bell Telephone Co., chosen as 1st vice-president. W. R. Emerson of the Oklahoma Gas & Electric Co., was re-elected secretary and treasurer of the organization.

Logan Cary, president of the Consolidated Gas Utilities, Oklahoma City, was elected as one of the three members of the executive board, representing the Gas Division. His term of office will be for three years. The other two members of the board representing the Gas Division are H. L. Montgomery and E. C. Deal, president of the Oklahoma Natural Gas Corp.

R. J. Daugherty, director of the Public Relations Department, Cities Service Gas Company, Bartlesville, was this year's chairman of the Public Relations Division and also represented the Gas Division on the resolutions committee of the Association.

Among the resolutions adopted by the convention was one favoring the designation of the Speaker's Bureau work of the Association as an activity of the Public Relations Division, and calling for a broadening of the activity of this Bureau through selecting a list of speakers able to discuss definite subjects that will meet definite situations developing in Oklahoma.

A resolution was also passed recommending the organization of a Public Policy Committee in the Association. Another recommendation called for approval by the convention of the proposed public information campaign to be begun as an activity of the Public Relations Division.

Utah Valley Gas & Coke Co. Properties are Sold

Utah Valley Gas & Coke Co. properties at Provo, Springville, Spanish Fork, Utah were sold at public auction on March 5 to Chase National Bank interests, trustees and plaintiffs in the action. A. M. Cheney, Salt Lake City attorney, offered the successful bid. in the amount of $335,000. It is understood that transfer of the properties to the Wasatch Gas Co., headquartered in Salt Lake City, Utah, will take place.

Missouri Valley Pipe Line Co. May Enter South Dakota

The house committee of Congress recently passed a bill permitting the Missouri Valley Pipe Line Co., of Omaha, Neb., to take its transmission lines into South Dakota.

MEASUREMENT and CONTROL

Classification *of* Continuous Flow Gas *and* Liquid Meters

By W. H. Davis

Vice-President, Pittsburgh Equitable Meter Company of California

DUE to their design and principle, meters used for the measurement of liquids and gases can be divided into two distinct groups, quantity measurement and rate of flow measurement.

There are a number of given types of quantity meters which are known by the style of measuring mechanism used in their construction. Two divisions might be made of quantity meters—for example, positive and inferential meters. The positive meters are commonly classified as weighing and volumetric. The weigh meter is often referred to as the tilting trap type. Some of the various types of volumetric meters are bellows, disc, piston, rotary, tank and wet drum. The inferential meters are often classified as current meters. A few of the types of current meters are helical, propeller and turbine.

W. H. Davis

The types of rate of flow meters are also known by the style of primary element used. This group of meters is classified under head (kinetic) area (geometric), head-area (weir), force and thermal. A number of examples of head meter types are venturi, flow nozzle, thin-plate orifice, Pitot, centrifugal and friction. Area types are gate, orifice and plug, cone and disc, cylinder and piston. Head-area or weir covers the various types of notch meters. Force types are hydrometric, pendulum and vane. Thermal meters are of the electric type.

The application, accuracy, uses and special qualifications of these various types of meters will be treated briefly.

The tilting trap or weigh meter is commonly known as the bucket type. When a predetermined weight of liquid fills the container the equilibrium of same is upset. This type of meter is used extensively in measurement of oil and steam condensation. It is quite accurate but cannot be used for gases.

The piston and disc meters are positive in action, and displace or carry over a fixed quantity for each stroke or nutation of disc. These meters are very accurate on small flows, and low pressures such as 5 lbs. They are seldom used in sizes to exceed capacity of 6-inch pipe, and are used extensively in measuring oils and water but are not suited for gases.

The bellows, D Type slide valve meter may well be represented as a slide valve engine having two cylinders and collapsible pistons which are the two leather diaphragms. These meters are very accurate for the measurement of gases but are not suited for liquids.

Rotary and wet drum gas meters are made for large volume measurement and serve well their special fields.

Current meters are suitable for the measurement of liquids with minimum absorption of pressure. These meters record the flow by the number of revolutions of their propeller. This type of meter is not so accurate on very small flows but is very popular in large volume measurement.

As the use of meters for larger volume increased the use of quantity meters became prohibitive on account of excessive weight and costs. The industry and meter manufacturers turned to various types of rate flow meters to solve the problem of smaller investment.

Probably the most popular of all rate flow meters is the thin-plate orifice type. The principle of orifice meter measurement which has in reality been pioneered by the gas and oil industry depends upon the accurate measurement of the pressure loss in a stream of flowing gas or liquid as it passes through a circular orifice. The Bureau of Standards, and various other agencies, have conducted all the necessary experimental work and test work to establish the coefficients to be used, and also to place limits on various factors which tend to cause inaccuracy in measurement. Thus at the present time all of the mathematics and engineering necessary for accurate orifice measurement have become well known, and established with all oil and gas companies.

The development of an instrument to measure the pressure loss across the orifice lagged somewhat behind the actual experimental work necessary to establish the mathematics of orifice coefficients. During the years of development of orifice meter measurement there have been very many changes, very many designs produced to record accurately the differential pressure across the plate, and also the necessary static pressure.

This type of meter is very flexible, will measure practically all liquids and gases.

The venturi, flow nozzle and thin-plate orifice meters are very closely related but on account of the readiness with which the thin-plate orifice type can be changed in the line either for inspection or replacement, this type is the most popular.

Under the classification of geometric area meters the gate type is the only one that is used commercially. In this style of meter the effective orifice area is increased or decreased by a special gate that slides across the opening of a circular orifice. The gate is operated by an electric motor.

There are a great many different styles of notch, or weir type meters. No doubt the B notch recording liquid meter is the most popular. It is extensively used in large power plants for recording the flow of boiler feed water. It consists of a metering tank

*Presented before the Southern California Meter Association, March 20, 1931.

Session *at* Oil Equipment Exposition

THE practice of holding its monthly business session during the Oil Equipment and Engineering Exposition dates, begun last year, was carried through again in March by the Southern California Meter Association. Meeting on the evening of Friday, March 20, at the Compton site of the Exposition, the organization provided a program of general interest to Exposition visitors.

H. N. Marsh of the General Petroleum Corp. delivered a paper on "Gas Injection", and W. H. Davis of the Pittsburgh Equitable Meter Co. had for his subject, "Classification of Fluid Meters." The latter is presented in this issue of *Western Gas,* and Mr. Marsh's discussion will appear in the May edition. Slides accompanied both papers.

The meeting adjourned in time to allow those present to inspect exhibits of the Exposition.

Schultz Now with L. A. Office of Foxboro

Vergil Schultz, formerly gas engineer for the Richfield Oil Co., and vice-president of the Southern California Meter Association, late in March became associated with the Foxboro Co. in a sales engineering capacity, working out of the company's Los Angeles office.

from which the water passes over a 90 degree V notch into a catch basin below, the height of water above the notch being recorded on a clock driven paper chart. An integrating device is also provided, and a recording temperature element for recording the temperature of the liquid.

The vane type meter is used quite extensively for measuring irrigation water.

The thermal meter, which is of the electric type, was used quite largely before the accuracy of the thin-plate orifice meter was so generally accepted. There is only one commercial type of this meter manufactured. It consists of an enlargement of section of the flow pipe into a chamber of a diameter equal to about two diameters of the pipe with conical ends connecting it with the pipe. In the interior is placed an electric heater made of bare resistance wire mounted on a fibre frame and equally distributed over the section of the chamber, and also two electric resistance thermometers, one in front and the other behind the heater. An electric current measured by a wattmeter is passed through the heater, and the temperatures before and after the heating are measured by these thermometers.

The commercial types of all these meters are constantly being improved, especially the secondary element which consists of the integrating, or other forms of recording. The constant aim of the manufacturer is to simplify their construction, thereby reducing the service costs of operation, and at the same time increasing the efficiency of the meters. They have been well rewarded for their efforts, as all industries are using more meters, thus giving the manufacturers a constant increase in production. New uses of meters are rapidly being accepted by the trade. As an example of this is the grease meter. Practically every state in the Union has passed laws requiring that all grease equipment dispensing grease at the automobile service stations be equipped with a grease meter for measuring the grease that is used in transmission and rear end lubrication.

Measurement *of* Non-Viscous Liquids by *the* Orifice Meter

By WILLIAM L. COWAN
*Union Oil Company of California**

THE purpose of this paper is to give a more general as well as a more simple method of calculating the flow of liquids through orifices than those now in use. Each manufacturer of gauges uses an individual set of tables accompanied by special formulae and constants. This has led to some confusion among men who are required to compute the liquid flow recorded by these various types of gauges.

With this in mind, the flow of liquids through orifices was studied carefully in regard to the basic theory underlying this type of measurement and to the types of gauges used to record the differentials, in order that tables could be made up which could be used jointly for computing flows recorded by practically any gauge on the market. Fundamentally, the coefficients and correction factors herein presented, when properly used represent the same flow as that obtained from the various methods now in use—except for slight differences, perhaps, in the coefficients, the standards, and possibly some of the constants used.

The average meter man will find practical use for the accompanying tables, which apply to practically all types of gauges. They are not intermingled with gas coefficients, and every factor shown has a definite specified meaning which can be traced back directly to basic theoretical and physical considerations. These orifice meter coefficients are put out in a similar form to those used for computing gas flows, that is, hourly flow in volume per hour at 60°F. (unless otherwise specified) equals a (coefficient) × (gravity factor) × (temperature factor) × (√Indicated inches of water diff.)

With these tables the need of determining the actual flowing specific gravity is unnecessary, for the specific gravity at flowing conditions is a direct function of the volumetric temperature correction and the specific gravity of the flowing liquid at 60°F. As specific gravity of petroleum liquids is practically always determined from °A.P.I. at 60°F., as determined by hydrometers and tables, the factors were figured per each ½°A.P.I. gravity at 60°F.

Essential Requirements for Liquid Orifice Meter Measurement

The theory entering into the measurement of non-viscous liquids by orifice meter is similar to the basic theory entering into the flow of gases by this method. In fact, the flow formula used for gases is taken primarily from the assumption that gas acts as a liquid at small pressure drops across orifices. The principal differences between liquids and gases are that:

(1) Liquids are comparatively incompressible and are non-expandable under constant temperature and do, therefore, have a relatively constant density regardless of pressure drop or changes in static pressure.

Gases, on the other hand, are perfectly expansive and compressible and therefore change their density appreciably at high pressure drops or when their static pressures are changed.

(2) For most of the common orifice meter operating conditions, practically all gases as well as the majority of liquids used commercially, can be assumed to be non-viscous without a great deal of error. However, many of the heavier petroleum liquids when cooled, *do become viscous* and therefore *do not* follow the same laws as free flowing fluids.

This discussion will deal only with those liquids which can be considered as non-viscous in the physical status in which they are commercially used. These relatively non-viscous liquids which do occur to the greatest extent in the natural gasoline and oil refining industries might roughly be grouped as follows:

(a) Water at various pressures and temperatures.

(b) Liquid petroleum products that give gravities which, when corrected to 60°F., are greater than 40° A.P.I. at 60°F.

(c) Liquid petroleum products having °A.P.I. gravities lower than 40°A.P.I. at 60°F. which are held at temperatures high enough to make them non-viscous.

(d) Other liquids often used commercially which might be considered as relatively non-viscous under many ordinary industrial conditions are carbon dioxide, hydrogen sulphide, salt water, sulphuric and other commercial acids, etc. These latter liquids, of course, do generally require special temperature corrections and probably additional gravity factors.

(3) One other consideration of utmost importance in regard to liquid measurements is that the liquid must be at a pressure great enough and at a temperature low enough to guarantee complete liquefaction. In other words, it must be kept at pressures greater than its vapor pressure at flowing temperature in all instances, for otherwise a variable density of the fluid occurs which ordinarily is not determinable and therefore the flow is immeasureable. In some special cases of overly saturated vapors, or in other words partially vaporized liquids, it is possible to assume a relatively constant density, and compute the flow reasonably correctly. Such a case is that of "wet" steam of constant quality. Other factors such as liquid accumulations ahead of or behind the orifice or at points along the meter tube in case of wet vapors, or gas pocketing in gauges, gauge lead lines and meter runs in cases of only partially vaporized liquids, often result in so many possibilities for errors that the result of the flow calculated by orifice meters or practically any other type of register usually becomes questionable unless very special care is taken in the design of the meter and gauge set-up.

(4) In measuring liquid flow (as well as overly saturated vapors) liquid must be used in lead lines from the orifice meter tube to the gauge as well as in the gauge itself. This liquid has a very appreciable weight which must be given careful consideration, while in the measurement of gas, the gas has practically no weight in comparison to the weight of the mercury in the gauge. In using mercury types of gauges, the weight of the liquid over the mercury must be corrected for. With the diaphragm type of gauge the only factor to be considered is that each of the gauge lead lines is completely filled with the same kind of liquid and that the same temperature variation is held throughout equal elevations of the gauge lines between the gauge and the meter run. It is also essential in this latter type of gauge where different types of sealing fluids are used, that the levels between sealing fluid and flowing fluid be identical in both of the gauge lead

*Presented before the Southern California Meter Association, February 26, 1931. This paper was prepared in explanation of a number of data sheets on measurement of non-viscous liquids, issued by the S.C.M.A. Standards Committee, of which the author is chairman.

lines. The effect of liquid seals for mercury type gauges will be discussed later, as well as a few other gauge piping requirements.

Derivation of Liquid Orifice Meter Flow Formula.

In order to simplify the derivation, as well as to put it in a form most generally understood, the theoretical velocity method will be given.

(1) $Q = C_v A V$ cu. ft. per sec. of liquid flowing through the orifice at line temperature and gravity.

where

C_v = an experimental coefficient of discharge of the orifice.

In the case of throat taps, 1 diam. up stream and ½ diam. downstream, C_v primarily represents (The ratio of the area of vena contracta to the area of the orifice) × (The ratio of actual velocity to the theoretical velocity) × (A correction to apparent differential due to velocity of approach). The values of C_v for throat taps are not given with this report.

In the case of flange taps, C_v primarily represents the same factors as it does in the case of throat taps, the contraction factor, however, possibly being slightly greater for flange taps. The values of C_v chosen for this report were interpolated from the abbreviated table recently published by the Foxboro Co. (S.C.M.A. Data Sheet No. 128).

In the case of pipe or line taps (2½ diam. upstream and 8 diameters downstream) C_v has a different meaning. It represents an experimental coefficient based on the orifice area and an assumed velocity which is equal to the velocity that could be created by the total actual fluid pressure head lost through the orifice. The values of C_v chosen for this report were those published by Metric Metal Works for gas. (S.C.M.A. Data Sheet No. 106).

Note: Foxboro's flangetap values of C_v check the unpublished water coefficients of the U. S. Bureau of Standards, within less than 1 per cent throughout the entire range of orifice to pipe diameter ratios.

Values of C_v used for line taps do not check the unpublished U. S. Bureau of Standards water coefficients within 1 or 2 per cent at either the lower or higher values of diameter ratios, but they do check them closely throughout the intermediate or working diameter ratios.

As a working table was badly needed and as the U. S. Bureau of Standards has not yet published its coefficients officially, it was decided to make up tables using the most authoritative data published to date. Further revisions can easily be made later if the need arises.

$$(2)\quad A = \frac{\pi}{4}\left(\frac{d}{12}\right)^2 \text{ Sq.Ft.}$$

A = Area of orifice in square feet.
d = Orifice diameter in inches.

(3) $V = \sqrt{2gH}$ ft. per sec. where

V = Theoretical velocity in feet per second and for

(a) Throat Taps=Approximately actual jet velocity at vena contracta.

(b) Flange Taps=Approximately actual jet velocity near vena contracta.

(c) Line Taps=Assumed velocity based on head loss.

g = Acceleration due to earth's gravity taken as 32.16 ft. per sec. per sec.

H = Static pressure drop across orifice at tap connections corresponding to C_v used in equation (1), measured in *feet head of liquid* at line temperature and gravity, flowing through orifice. It is equivalent to the difference in pressures at the taps of horizontal orifice meter run which taps are at equal elevations above the ground.

H is ordinarily *recorded* in h inches of head of water pressure. The recording instruments generally used are assumed to be at 60°F.

Water at 60°F. is taken as the basis for all computations and is given a specific gravity $G_w = 1.000$.

By dividing the weight at flowing temperature of a unit volume of any given liquid by the weight of a unit volume of water at 60°F. the flowing specific gravity of this liquid = G_t can be found directly.

Where the volumetric temperature corrections T_c for the flowing liquid are definitely known and the weight per cubic foot of this same liquid is also definitely known at a temperature of 60°F. the weight of the liquid at flowing temperature per unit volume can be determined directly.

Let

w = Weight of unit volume of water at 60°F.
w_{60} = Weight of unit volume of other liquid at 60°F.
w_t = Weight of unit volume of same other liquid at T°F.
T_c = Volumetric temperature correction factor of other liquid for any flowing temp. T°F. corresponding volume at T°F. to its equivalent volume at 60°F.
G_w = Specific gravity of water at 60°F. = 1.000.
G_{60} = Specific gravity of liquid flowing in line corrected to 60°F.
G_t = Specific gravity of liquid flowing in line at flowing temperature T°F.
h = Net inches of water differential pressure at 60°F.

If the differential H in feet head of flowing fluid is actually measured in *net* h inches of water pressure

$$(4)\quad H = \frac{hw}{12 w_t}$$

= ft. head flowing fluid and

$$(5)\quad G_t = \frac{w_t}{w}$$

by definition.

Substituting $\frac{1}{G_t}$ for $\frac{w}{w_t}$ in (4)

$$(6)\quad H = \frac{h}{12 G_t}$$

Consider a unit volume of liquid at 60°F. weighing w_{60} wt. units that is expanded to T°F., then

$$(7)\quad w_{60} = \frac{w_t}{T_c} \quad \text{or} \quad w_t = w_{60} \times T_c$$

by definition.

$$(8)\quad G_{60} = \frac{w_{60}}{w}$$

Substituting the value of w_t from (7) in (5)

$$(9)\quad G_t = \frac{w_{60} \times T_c}{w}$$

or from (8) and (9)

$$(10)\quad G_t = G_{60} \times T_c$$

and substituting for G_t in (6)

$$(11)\quad H = \frac{h}{12\, G_{60}\, T_c}$$

and (3) becomes

$$(12)\quad V = \sqrt{\frac{2g \times h}{12\, G_{60}\, T_c}} \text{ ft./sec.}$$

By inserting the substitutions for A and V as determined in equations (2) and (12) respectively, in equation (1)

$$(13)\quad Q_f = C_v \left(\frac{\pi d^2}{4 \times 144}\right) \sqrt{\frac{2 \times 32.16 h}{12\, G_{60}\, T_c}}$$

cu. ft. per sec. at T°F.

To obtain the flow of liquid in *gallons per hour at 60°F.*

$$(14)\quad Q_{60} = Q_f \times 60 \times 60 \times 7.48 \times T_c$$

= gals. per hr. at 60°F.

Which, when simplified becomes

$$(15)\quad Q_{60} = 340.0\, C_v d^2 \sqrt{\frac{h T_c}{G_{60}}}$$

= gals. per hr. at 60°F.

Diaphragm Type Gauges

Equation (15) is the one used with meters of the diaphragm type, for the indicated differential h′ as recorded by these types of gauges is ordinarily the true net differential h in inches of water at 60°F., or h = h′ in case of diaphragm gauges.

If the indicated differential h′ is recorded by means of a direct reading or square root type chart and the differential range of the meter is K inches of water and if the square root chart reading is R chart units,

$$(16)\quad \sqrt{h'} = R\sqrt{\frac{K}{100}} \text{ Where } \sqrt{\frac{K}{100}} = M$$

$$(17)\quad h' = R^2 \frac{K}{100} \text{ Where } \frac{K}{100} = M^2$$

M and M^2 being constants for any one gauge.

Following are values of M and M^2 for most of the ranges of commercial gauges used. As the $\sqrt{h'}$ is the value used in computing flow by orifice meters, the value M from (16) is used in the form of a direct factor. This factor M is ordinarily incorporated directly into the hourly or daily coefficient used.

Inches of Water Differential Range of Gauge	M^2	M
2.5	.025	.1581
10	.100	.3162
20	.200	.4472
25	.250	.5000
50	.500	.7071
60	.600	.7746
100	1.000	1.0000

Determination of the True Differential Pressure (h) from the Indicated Differential (h′)

In liquid measurement by orifice meter, probably the greatest possibilities for errors occur in the determination of and in the

methods of recording h, the true differential pressures, in inches of water at 60°F. Some types of gauges have one definite type of correction while other types of gauges require other types of corrections. There are other corrections depending on fluid conditions in the lead lines and meter tube, temperature variations, design of meter run (and whether vertical or horizontal), gas or air pockets, etc., which are common to both types of gauges. Before showing the corrections required for the mercury gauges alone, some of the other fundamental lead line requirements and common inherent errors in gauge piping will be discussed.

Gauge Piping in General

When either diaphragm or mercury gauges are used to obtain differential pressures of liquids flowing through orifices, the gauge lead lines *must* be completely filled with *some liquid.* The static liquid pressure in the flow line plus or minus a definitely known pressure due to the head of liquid of known density in the gauge lines must be transmitted to the working areas of the gauges. There must be no possibility of gas pockets collecting in either the gauge lead lines or gauges which will prevent this transfer of pressure. Gas pockets at some points have no effect upon this transfer while others may cause serious errors, depending entirely upon where they are located.

Effect of Gas Pockets in Gauge and Gauge Lines

Fig. 1 shows the effects of harmless gas pockets. Consider the liquid in the line to be under a pressure head of liquid = (10 ft. liquid) then $P_a = 10$ ft. liquid pressure. P_b being at the same level as P_a must also be equal to P_a (10 ft. liquid pressure) even though gas does occupy a space above B. The pressure of the gas at C if liquid rises 2 ft. above B must be 10 ft. — 2 ft. or 8 ft. of liquid.

It is seen from this diagram that the gas pocket at C has no effect on the actual metering.

Consider point D and a possible gas pocket (such as is shown in Fig. 1) in the top of the mercury chamber. The pressure of this gas at D must be equal to (10 + 4) or 14 ft. head liquid, while the pressure of the liquid itself must also be 14 ft. head of liquid and the pressure exerted on the mercury, 1 in. below this level, by the liquid will still be 14 1/12 ft. liquid which is the true desired pressure.

However, had a gas pocket formed so that the liquid would not be able to exert its full head of pressure on the top of the mercury, as shown in Fig. 2, a very grave error would be caused. Let $P_a = 10$ ft. head liquid; then due to the gas, the pressure at B would be 9 ft. liquid and at C 11 ft. liquid instead of the 14 1/12 ft. as in Fig. 1.

Wherever it is possible to do so the same liquid as that flowing through the orifice should be used in the gauge lead lines. In case of water or the lighter petroleum fluids listed here there is no real need to use any sealing liquid, except perhaps in severe cases where partial vaporization of the flowing liquid occurs occasionally. When the need of these special sealing fluids arises, special pots are needed, and it is also necessary to make additional corrections for the weight of and the movements of the changing liquid levels when differential pressures over the orifice are exerted. With the newer type of diaphragm gauge there is usually no appreciable displacement of liquid with fairly large differentials and therefore no further correction is usually necessary unless the liquid levels of seals and flowing fluid were

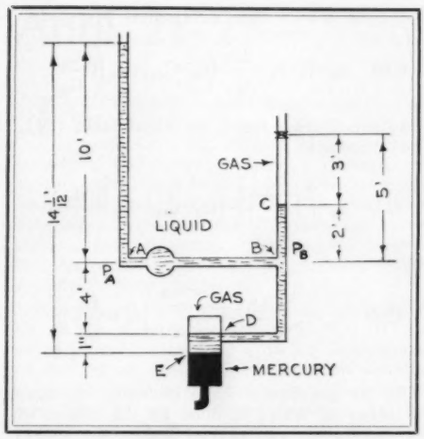


Fig. 1

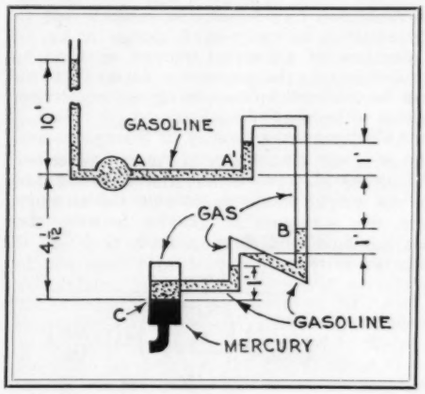


Fig. 2

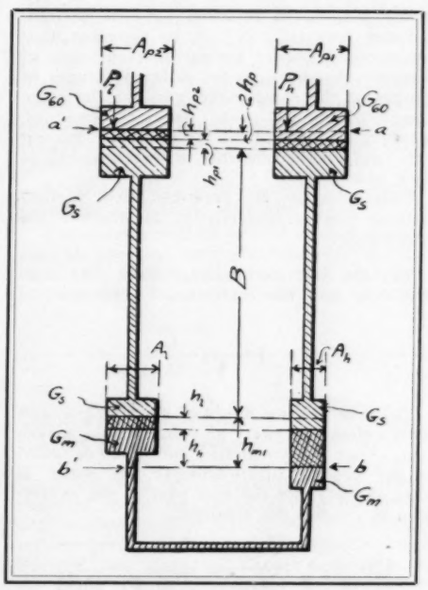


Fig. 3

not correct at the start. This statement applies only to horizontal meter runs.

Consider first a *horizontal line* with the fluid in gauge lines the same as that flowing through the orifice except that it is at atmospheric temperature. It has been assumed in all the following calculations that the liquid in the gauge lines attains an average temperature of 60°F. regardless of flowing temperatures. There are some appreciable errors brought in on this assumption occasionally. Atmospheric or gauge temperatures are often greater or less than 60° which in some instances might affect accuracy of gauge calibration as well as affect density of fluid in the gauge lines. This error in almost all cases can be neglected, especially if the temperature gradients are always equal at equal elevations of gauge lines. However, should one line attain a higher temperature than the other, due possibly to the proximity of a hot pipe or to a greater change of liquid in one gauge line caused by differences in gauge chamber areas and a fluctuating flow, an error worthy of consideration might occur. For instance if 3 ft. of vertical gauge line was at an average of 60°F. and the corresponding 3 ft. of the other gauge line was held at an average of 120°F. an error in the recorded differential h′ would, for a 70° A.P.I. at 60°F. gasoline be equal to

$36\,G_{60} - 36\,G_{60}\;T_c = 36 \times .7022(1. - 0.9578)$
$= 1.067$ inches of water error.

Elimination of such an error in some cases can be remedied by using pots of large size and surface exposure or in other cases by moving gauge lines further away from temperature disturbances.

Another factor worthy of consideration is that of some foreign fluid collecting in the gauge lines. Temporarily neglect the effect of liquid over mercury in case of a mercury gauge. Suppose a foreign liquid having a S.G. = G_1 collected in one gauge line for a height of Y vertical inches and in the other gauge line at an equal elevation the liquid had a S.G. = G_2, then the error expressed in inches head of water would be $Y(G_1 - G_2)$, assuming the foreign liquid was heavier than the normal liquid G_2. These above errors would be additional corrections to h′ in the form of addition or subtraction to the indicated h′ before taking the square root. In any event, the gauge piping should be so arranged that no foreign fluid can collect where it will cause incorrect pressures to be recorded.

Inherent Corrections to Indicated Differential h′ for Mercury Type Gauges.

For this one illustration consider the meter run horizontal, and to be complete assume that a heavy sealing fluid is used and also that the gauge is placed below the meter tube. Although the following corrections to h′ are figured for gauges placed below the line it can be shown that the formula devised holds true for gauges placed above the line. Consider the diagrammatic illustration shown in Fig. 3.

Nomenclature of Symbols—Fig. 3

G_{60} = S.G. flowing liquid at 60°F.
G_s = S.G. sealing liquid at 60°F.
G_m = S.G. mercury liquid at 60°F.
A_{p1} = Horiz. area of sealing pot upstream side.
A_{p2} = Horiz. area of sealing pot downstream side.
It is assumed that

$$A_{p_1} = A_{p_2} = A_p$$

A_h = Horiz. area H.P. mercury chamber
A_l = Horiz. area L.P. mercury chamber
h_{p1} = Vertical height sealing fluid moves down in H.P. seal. pot.
h_{p2} = Vertical height sealing fluid moves up in L.P seal. pot.

$$2h_p = h_{p_1} + h_{p_2}$$

h_h = Vertical height sealing fluid down in H.P. mercury pot.

h_l = Vertical height sealing fluid moves up in L.P. mercury pot.
h_{m_1} = Vertical difference in final mercury levels = $h_h + h_l$
P_h = true static flowing line press. at upstream tap in inches head of liquid G_m
P_l = true static flowing line press. at downstream tap in inches head of liquid G_m
$h_m = P_h - P_l$ = true differential pressure across orifice tap, in inches head of liquid G_m
B = distance from lowest point of H.P. sealing pots to the highest points on mercury pots to which sealing fluid reaches.

When no differential occurs the levels of sealing fluid in both sealing pots are identical as are those in the mercury pots. When a differential pressure is exerted the sealing fluid moves down in both the high pressure sealing pot and also in high pressure mercury chamber while it rises in the downstream sealing pot and downstream mercury chamber. In high pressure sealing pot, the sealing fluid is displaced by flowing fluid of S.G. = G_{60} while in high pressure mercury chamber the sealing fluid displaces mercury. In the downstream sealing pot and mercury chamber the displacements are reversed. However, in all four cases the *volume of displacements are equal.*

Therefore it can be seen that:

$$(18)\quad A_{p_l} h_{p_l} = A_h h_h = A_l h_l = A_{p_2} h_{p_2}$$

where $A_{p_l} h_{p_l} = A_{p_2} h_{p_2} = A_p h_p$

$$(19)\quad h_h = h_l \frac{A_l}{A_h}$$

and from Fig. 3

$$(20)\quad h_h = h_{m_1} - h_l$$

Substituting for h_h in (20) from its value in (19)

$$(21)\quad h_l \frac{A_l}{A_h} = h_{m_1} - h_l \quad \text{or}$$

$$(21')\quad h_{m_1} = h_l \left(\frac{A_l}{A_h} + 1\right) \quad \text{and}$$

$$(22)\quad h_l = \frac{h_{m_1}}{\left(\frac{A_l}{A_h} + 1\right)}$$

then from (18)

$$(23)\quad h_p = h_h \frac{A_h}{A_p} = h_l \frac{A_l}{A_p}$$

then from 22 and 23

$$(24)\quad h_p = \frac{h_{m_1}}{\left(\frac{A_l}{A_h} + 1\right)} \frac{A_l}{A_p}$$

Considering that after a differential pressure $(P_h - P_l)$ is once exerted there is no further movement of levels until this pressure difference is changed, the total pressure exerted on both sides of the complicated 'U' tube are therefore equal at b and b'. Placing these liquid and static pressures in unit heads of liquid pressure G_m the following formula is the result:

$$(25)\quad P_h + 2h_p \frac{G_{60}}{G_m} + B\frac{G_s}{G_m} + h_{m_1}\frac{G_s}{G_m} = P_l + 2h_p \frac{G_s}{G_m} + B\frac{G_s}{G_m} + h_{m_1}$$

and from which true differential pressure

$$(26)\quad h_m = P_h - P_l = \frac{2h_p}{G_m}\left(G_s - G_{60}\right) + h_{m_1}\left(1 - \frac{G_s}{G_m}\right)$$

By substituting for h_p its value from (24), (26) becomes

$$(27)\quad h_m = \frac{2}{G_m}\left(\frac{h_{m_1}}{\frac{A_l}{A_h}+1}\right)\frac{A_l}{A_p}\left(G_s - G_{60}\right) + h_{m_1}\left(1 - \frac{G_s}{G_m}\right)$$

$$(28)\quad h_m = h_{m_1}\left[\frac{2A_l}{G_m A_p}\left(\frac{G_s - G_{60}}{\frac{A_l}{A_h}+1}\right) + \left(1 - \frac{G_s}{G_m}\right)\right]$$

As the conversion from inches of mercury to inches of water is done by the means of leverage arms and special scales, the inches of water differential h would equal $h_m \times 13.58$ while the apparent differential recorded would be $13.58 \times h_{m_1}$. Consequently as these two factors enter in on each side of the equation and any small change in h_{m_1} is equivalent to an actual change of $13.58 \times$ (the change), the conversion factor (13.58) can be omitted in computing the correction factor to be applied to h_{m_1}.

As orifice meter flow is in reality proportional to the $\sqrt{h_m}$ the orifice meter correction factor for the false differential recorded due to the weight of the liquid over the mercury and the difference in gravity between the sealing fluid and flowing fluid at 60°F. is then equal to

$$(29)\quad F = \sqrt{\frac{2A_l}{G_m A_p}\left(\frac{G_s - G_{60}}{\frac{A_l}{A_h}+1}\right) + \left(1 - \frac{G_s}{G_m}\right)}$$

This factor F can be combined with either the temperature factor $\sqrt{T_c}$ or to the gravity factor $\sqrt{1/G_{60}}$ in equation (15) as desired.

From formula (29) it is apparent that *for mercury gauges* having different sizes of mercury chambers, or for different ranges of gauges of the same make, and for the same range of gauge using different sizes of mercury chambers with the same size sealing pots, different coefficients will be needed in each case.

This being so, the practical way of eliminating this irregularity is to observe the following:

(a) Do not use sealing fluid, for then $G_s = G_{60}$ and the correction F becomes

$$(30)\quad F = \sqrt{1 - \frac{G_{60}}{13.58}}$$

(b) Use sealing fluids of specific gravities very close to that of G_{60} which makes $(G_s - G_{60})$ very small, and the equation might become approximately the same as that of (30), for the first part of the expression is usually the smallest.

$$(31)\quad F_2 = \sqrt{1 - \frac{G_s}{13.58}} \text{ or approx } \sqrt{1 - \frac{G_{60}}{13.58}}$$

(c) Use sealing pots of large enough cross-sectional area to make the first part of the expression negligible, making the correction factor approximately equal to

$$(32)\quad F_3 = \sqrt{1 - \frac{G_s}{13.58}}$$

(c)' In the above case if a seal is used, use water as the sealing fluid, for then a set of factors can be worked out that will suffice for any set of gauge installation of this character, making a constant factor.

$$(33)\quad F_3' = \sqrt{1 - \frac{1}{13.58}} = 0.96248$$

Errors Involved in Vertical Meter Runs (See Fig. 4).

The error in vertical meter runs measuring liquid, is due to the fact that the head of liquid inside the meter run is at a different temperature than that in the gauge line. The resulting error can be calculated as follows:

(a) Consider a diaphragm type gauge, no liquid seals.

Let

P_1 = Static up stream line pressure in inches of water at 60°F.
P_2 = Static down stream line pressure in inches of water at 60°F.
G_{60} = S.G. of flowing fluid at 60°F.
G_t = S.G. of flowing fluid at line temp.
$h_1 + h_2$ = B inches.
h = True flow differential pressure inches water at 60°.
h' = Indicated differential pressure inches water at 60°.
P_3 = Upstream press. on gauge inches water at 60°.
P_4 = Downstream press. on gauge inches of water at 60°.

True Differential Pressure

$$(34)\quad h = P_1 - P_2 + BG_t \text{ or}$$

$$(34)'\quad P_1 - P_2 = h - BG_t$$

$$(35)\quad P_3 = P_1 + h_1 G_{60} \text{ and}$$

$$(36)\quad P_4 = P_2 - h_2 G_{60} \text{ from which}$$

$$h' = (P_1 + h_1 G_{60}) - (P_2 - h_2 G_{60}) \text{ or}$$

$$h' = (P_1 - P_2) + G_{60}(h_1 + h_2)$$

$$(37)\quad h' = (P_1 - P_2) + BG_{60}$$

Substituting value of $(P_1 - P_2)$ from equation (34)' in (37)

$$(38)\quad h' = h - BG_t + BG_{60} \text{ or}$$

$$h = h' + BG_t - BG_{60} \text{ or}$$

$$(39)\quad h = h' - B(G_{60} - G_t)$$

and the orifice meter correction becomes

$$(40)\quad \sqrt{h} = \sqrt{h' - B(G_{60} - G_t)}$$

It is apparent that the above correction is a very difficult one to make in practice, for the expression $B(G_{60} - G_t)$ is not a function of the indicated differential. For any given flowing temperature it is a constant for any one meter run. The greater the line size the larger (B) becomes with line taps. Where the error in this case is large enough to require a correction, it is seen that the indicated *inches* of water differential h' must actually be figured out and the correction added, the variation of the error depending upon value of h', the error being greater

at small values of h^1 than at large ones. Use of square root charts would be a handicap in this case.

From the above it is clear that flange taps should be used in all cases of this kind where a flowing line temperature is appreciably different than atmospheric.

This correction should also apply to mercury gauge readings as follows, h^1 being in

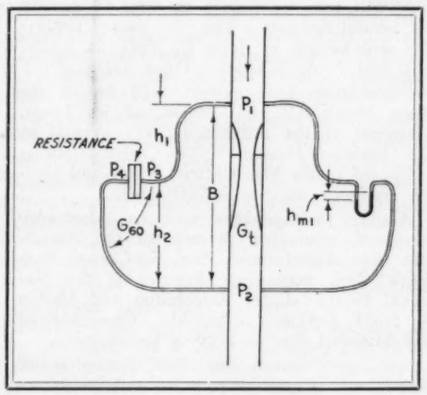


Fig. 4.

indicated inches of water. See Fig. 4 and formulas (40) and (30).

$$(41)\quad \sqrt{h} = \sqrt{h^1 F - B(G_{60} - G_t)}$$

No attempt has been made to show this correction in the tables accompanying this paper. The correction is so out of line with the methods of figuring flow by means of direct factors that such a metering condition where temperature effects are serious, should not be used.

(Concluding his discussion in the May issue Mr. Cowan will present six tables, giving hourly orifice coefficients and orifice meter temperature-gravity factors for water and light petroleum liquids, together with an explanation of their use.—Editor).

Eastland Compressor Station of Lone Star Being Rebuilt

The Eastland compressor station of the Lone Star Gas Co., of Dallas, Texas damaged to the extent of $15,000 by a February fire, is being rebuilt under the direction of L. H. Taylor, in charge of construction for the company in the West Texas area.

Texas Cities Gas Co. to Build Two Metering Stations

Texas Cities Gas Co., El Paso, Texas, has been granted location sites for erection of two metering stations on Mexican Federal property along the south bank of the Rio Grande in Juarez, to be constructed for the Juarez Gas Co., S.A., of which E. Revilla is manager.

Swearingin Now With Council Bluffs Gas Co.

Isaac Swearingin, formerly construction foreman for the Fort Worth Gas Co., of Fort Worth, Texas, has accepted the position as general construction foreman for the Council Bluffs Gas Co., Council Bluffs, Iowa.

April 21-23—Meter Short Course Dates

THE eighth annual Southwestern Gas Measurement Short Course will be held April 21, 22 and 23 at the University of Oklahoma at Norman. Conducted by the university's School of Engineering, the Short Course is sponsored by the American Gas Association, the Natural Gasoline Association, the Oklahoma Utilities Association, Oklahoma Corporation Commission and equipment manufacturers.

Attendance has steadily increased from 60 at the first meter school to 450 at the seventh, indicating the growing importance of this phase of practical education for gas men and the interest shown by measurement men from all parts of the country. At last year's school representatives from 20 states and 2 foreign countries were present and the average attendance in classes was 95 per cent of the number of men registered.

The school is conducted as a combination of a few general meetings with technical papers and discussions, and a large number of small classes on particular subjects led by men experienced in the industry, where the personal experiences of everyone in the group are compared. Other classes are held on individual pieces of equipment and are led by special factory service men furnished by equipment companies having exhibits at the school.

The general program will offer a number of addresses from leaders in the natural gas and related fields. E. J. Stephany, secretary of the Natural Gas Department of the American Gas Association, will deliver an address at the opening session of the Short Course. Since the inception of the course the A.G.A. has given the school its active cooperation and endorsement.

R. J. S. Pigott, chairman of the Fluid Meters Committee, American Society of Mechanical Engineers, will give an address. Professors W. H. Carson and E. F. Dawson of the University of Oklahoma faculty, will discuss problems in elementary and fundamental gas laws of particular interest to men constantly concerned with the technical processes involved in the measurement and regulation of gas.

R. G. Miller, secretary of the Natural Gasoline Asociation, will also speak.

The courses will be offered in such manner that all enrolled may participate in the discussions. Classes will deal with such subjects as the fundamental principles of orifice and positive meters and regulators, calculation of wet and dry orifice meter charts and of pressure, volume and temperature charts, open flow of gas wells, operation of orifice meters, functions of field metermen, operation of the slide-rule, field testing of positive meters, problems of wet gas measurement, discrepancies in line loss statements, reconditioning of mercury, and many other problems of the industry.

Aside from these general subjects, particular operations and varied equipment will be presented by factory representatives, who will have exhibits of standard apparatus and newest developments while the school is in session.

C. B. Day, Consolidated Gas Utilities Co., Blackwell, Okla., is chairman of the general committee in charge of arrangements. W. H. Carson, professor of mechanical engineering at the Oklahoma University, is active director of the Short Course and chairman of the banquet and entertainment committee. Other committee chairmen are as follows:

B. L. Maulsby, Oklahoma Natural Gas Corp., Tulsa, program committee; W. R. McLaughlin, Arkansas Natural Gas Corp., Shreveport, La., committee for the study of practical methods; E. F. McKay, Oklahoma Utilities Association, Oklahoma City, registration committee; E. W. Rowland, The Empire Companies, Bartlesville, Okla., publicity committee.

Companies wishing to exhibit equipment, which is limited to use in the measurement and regulation of gas, are referred to E. E. Stovall, Lone Star Gas Co., who is chairman of the exhibits committee.

Also serving on committees are R. H. Lussky, Oklahoma State Corporation Commission; R. D. Turner, Skelly Oil Co., Tulsa, Okla.; A. J. Kerr, Midwest Equitable Meters Co., Tulsa; G. P. Bunn, Phillips Petroleum Co., Bartlesville; D. C. Williams, Kay County Gas Co., Ponca City, Okla.; Eugene Metz, American Meter Co., Kansas City, Mo.; F. C. Walters, Panhandle Eastern Pipe Line Co., Kansas City; L. G. Rheinberger, Sinclair Oil and Gas Co., Tulsa; Ray G. Miller, secretary of the Natural Gasoline Association, Tulsa. Ex-officio members are E. A. Clark, Columbia Gas and Electric Co., Pittsburgh, Pa.; F. D. Franks, Cities Service Gas Co., Bartlesville, and D. A. Sillers, Lone Star Gas Co., Dallas.

South Plains Pipe Line Co. To Extend Service

Construction work totaling 100 miles is expected to be completed during the spring and summer which will bring natural gas service to Spur, Dickens, McAdoo, Roaring Springs and Matador, Texas, from lines of the South Plains Pipe Line Co., headquartered at Lubbock, Texas. West Texas Gas Co., a subsidiary, will distribute the gas.

Work Progressing on Line From Fresno to Merced

Work on the new 60-mile, 8-inch transmission line from Fresno, Calif., to Merced, being constructed by Pacific Gas and Electric Co., of San Francisco, is expected to be complete some time in April. Madera is expecting gas service early in April, where a franchise has been asked by San Joaquin Light & Power Corp. of Fresno.

Jefferson City to Change To Natural Gas

The city council of Jefferson City, Mo., has granted the Missouri Power & Light Co., Kansas City, Mo., permission to supply the city with natural gas instead of manufactured, supply to come through an extension from the Panhandle Eastern Pipe Line Co.'s carrier.

Langston to Vote on Franchise

March 31 was the date set for a gas franchise election at Langston, Okla. The petitioner is the Pact Gas Co., of Cushing.

A session of the Kansas City Gas Co. employee-customer relations course

Successful Employee-Customer Relations Course

A COURSE in the development of employee customer relations held by the Kansas City Gas Co., Kansas City, Mo., has proven so successful that company executives announce plans to make it an annual affair.

W. A. Irwin, professor of economics, Washburn University, was employed as a lecturer, the class having an enrollment of 147 and an average weekly attendance of more than 300. These meetings began in January, and are being held every Tuesday night in the general offices of the company, to continue until April 15.

The sessions were originally planned under the Employee-Customer Relations program of the American Gas Association, but this has expanded to include the university lecturer and other innovations.

Southern Fuel Co. Lets Pipe Contracts on 210-Mile Line

Southern Fuel Co., 740 So. Broadway, Los Angeles, has placed an order for 76 miles of pipe with Western Pipe and Steel Co., delivery to begin on July 15. The pipe will be used for a portion of the company's 210-mile, 26-inch line from Kettleman Hills field to Los Angeles and Long Beach.

A. O. Smith Corp., Milwaukee, Wis., has received an order from the same company for the remaining 131 miles of pipe for the same line.

Southern Fuel will let contract for an initial 30 miles of the carrier about the first of April.

Temporary field headquarters for the company have been opened at the old Midway Terminal, in Glendale.

Union Public Service Changing Ft. Scott Lines to Intermediate

Union Public Service Co., Fort Scott, Kan., is making preparations to convert some of its existing lines in that city to intermediate pressure. The project will enable the company to bring gas into the city from either of three sides. Regulator stations will be constructed on the west, north and southeast boundaries of the city.

Fort Worth Zoo is Heated with Natural Gas

Fort Worth Gas Co., Fort Worth, Texas, recently completed a novel gas installation at the Forest Park Zoo in that city. Gas steam radiators were installed in the monkeys' cages, while an open space heater was placed in the elephants' home, the heater being protected from an inquisitive trunk by a heavy wire screen. It is reported that the elephant grew to such an extent following installation of gas heat that it was necessary to

Laclede Franchise Goes to Central States Gas Utilities

Central States Gas Utilities Co., affiliated with Panhandle Eastern Pipe Line Co., Kansas City, Mo., has been granted a natural gas franchise in Lacledo, Mo., and has also applied in Meadville and Centerview, Mo. The company previously was granted franchises in Minneola, and Bucklin, Kan.

United Extends Service for Oil Drilling Operations

United Gas System, Houston, Texas, recently extended natural gas service for oil drilling operations in the Joiner, Kilgore and Longview areas of Texas. At the present time 74 drilling rigs are being run by natural gas, served through lateral lines off the various main lines in the section.

Wilson to Assist English in Standard M. & O. Corp.

G. O. Wilson, formerly with Standard Oil Co., of Calif. has been named assistant to President E. F. English of the Standard Management and Operating Corp., San Francisco, Calif.

Applies to Serve Vermilion

Missouri Valley Pipe Line Co., Omaha, Neb., has applied for a franchise to serve natural gas in Vermilion, S. D.

25th Annual Convention of Missouri Assn. of Public Utilities

THE 25th Annual Convention of the Missouri Association of Public Utilities will be held April 16, 17 and 18 at Excelsior Springs, Mo.

As this will be the "silver anniversary" of the organization, several old-time members will take part in a celebration during the annual banquet. The "old timer" festivities will be led by John C. Hall, St. Louis, Mo. and J. A. Whitlow, Tulsa, Okla.

Convention headquarters will be at the Elms Hotel. H. M. Patton, of St. Louis, president of the association, will preside at the business sessions. The association is composed of the gas, electric, water and electric railway utilities in Missouri.

Among the speakers will be Alexander Forward, managing director of the American Gas Association; Paul S. Clapp, New York City, managing director of the National Electric Light Association and Milton R. Stahl, Jefferson City, Mo., Chairman of the Missouri Public Service Commission.

An open forum for the discussion of timely utility problems will be held at an evening session April 16. The leader of the discussion on gas will be E. D. V. Dickey, Citizens Gas Co., Hannibal, Mo.

A special entertainment program will be provided for the ladies accompanying delegates to the convention. The Program Committee is composed of: Dudley Sanford, St. Louis County Gas Co., Webster Groves, chairman; H. H. Kuhn, Kansas City Power & Light Co.; L. W. Helmreich, Capital City Water Co., Jefferson City; H. G. Wehnert, Laclede Gas Light Co., St. Louis.

Members of the Entertainment Committee are: Hermann Spoehrer, Union Electric Light & Power Co., St. Louis, chairman; Paul C. Ford, Kansas City Gas Co.; B. W. Frauenthal, St. Louis Public Service Co.; J. B. Rogers, Missouri Power & Light Co., Excelsior Springs; John P. Casey, St. Louis.

W. L. Hoyt to Manage for Basford Co. at Los Angeles

WILLIAM L. HOYT has been named manager for the Los Angeles district for the H. R. Basford Co., with offices at 911 South Grand Ave., Los Angeles. Mr. Hoyt was formerly headquartered in San Francisco as Pacific Coast representative for the Ideal Gas Boiler Division of the American Radiator Co.

W. L. Hoyt

H. R. Basford Co. represents the Rudd Manufacturing Co. and the Fraser Furnace Co.

Mr. Hoyt's appointment was effective March 1.

Amarillo, Texas, to Have Municipal Gas System

The city of Amarillo, Tex., has contracted with the Huber Petroleum Co., to furnish natural gas for a municipal system from its wells in Hutchinson County. A 40-mile, 6-inch line will be laid to Amarillo in the near future, according to present plan.

High-Lights on the Missouri Valley Co.'s Line

Natural gas from the Texas fields was expected to be at the city gates of Fort Dodge and Mason City, Iowa, by April 1, according to reports credited to John H. Maxon, general manager of the Missouri Valley Pipe Line Co., headquartered at Omaha, Neb. The company is completing its 24-inch pipe line from the Panhandle to Fort Dodge, with a 20-inch extension to Mason City. Plans are also under way for construction of a lateral to serve Des Moines early in the summer.

Lone Star Gas Co., interested financially in the line, is constructing a compressor station at Mullinsville, Kan., using three 170-h.p. Cooper-Bessemer engines and four 262-h.p. Worthington engines. Completion of the plant is expected early in April. A site for a compressor station has also been secured near Ogden, Iowa.

Lone Star has completed a bridge across the Platte river near Fremont, Neb., which will carry the 16-inch natural gas line owned by the Missouri Valley Pipe Line Co. The bridge is a two-cable suspension type with a span of about 500 feet in length. It is located on the Lincoln-Sioux City branch of the new carrier.

Cox to Replace McFarland As Secretary of Southern Counties

AFTER 22 years service as secretary of the Southern Counties Gas Co., Los Angeles, Calif., Walter S. McFarland tendered his resignation to the board or directors on March 18, to take effect on April 1. E. C. Cox, for the past 2 years assistant secretary of the company, has been elected to succeed Mr. McFarland.

E. C. Cox

As one of the organizers of the company in 1911, Mr. McFarland aided in the consolidation of the Covina Gas Co., and the Piedmont Gas Co., gas properties of Southern California Edison Co. in Whittier and Santa Ana, and small gas plants in Anaheim, Orange and Fullerton under the name of the Southern Counties Gas Co.

During his association with the company it has grown from 4,000 consumers and a capital investment of approximately $1,000,000 to 140,000 consumers served in five counties and an invested capital of more than $25,000,000.

Mr. Cox, who will take over the office of secretary on April 1, has been with the company since 1920, entering the service as traveling auditor. Prior to his connection with Southern Counties, he was in charge of the inventory of the entire overhead system of the Philadelphia Electric Co., Philadelphia, Pa., and for 10 years previous to that, 1908-1918, he was an accountant with the Lehigh Valley Railroad Co.

Mr. Cox is regional chairman for the Pacific Coast of the customer ownership committee of the American Gas Association, and chairman of a similar committee of the Public Relations Section of the Pacific Coast Gas Association.

Twenty-two electric ranges were replaced by modern cabinet type gas ranges during a short period at Lubbock, Texas. The sedan delivery car is used by the company's new business manager and displays a slogan—"Employ Natural Gas—The Ideal Servant."

West Texas Gas Co. Employee Sales Plan

WEST TEXAS GAS CO., headquartered at Lubbock, Texas, serving about 40 towns in the western section of the state, extending from Canyon on the north to Midland on the south, recently inaugurated a sales plan in which every employee becomes a salesman for the company.

Towns served range in size from 40 meters to 4,000 meters. Thus the company finds it impossible to set up a merchandising department separate from the operating department, and depends entirely upon managers of branch offices to sell merchandise in their towns as a part of their duties while employed by the company.

Reproduction of the gold pin to be given to each employee reaching his quota.

As one phase of the company's sales plan for the year 1931, each employee is given a quota of sales of $1,200, and as a reward for selling his quota he will receive a gold monogrammed emblem in the form of the pin or coat lapel button illustrated above.

It is not compulsory that the employee close the sale himself, but he must have contacted the prospect and be the first to turn the name to the local manager. The sale is then closed by the manager.

Since the sales quota is the same for each employee, the sales manager must sell his own quota as well as assisting in making sales for those under his direction. Thus one of the qualifications of holding the position of manager is sales ability.

Sales charts are posted in each office with the names of each employee in that office on the chart. At the end of the month individual sales are recorded on the chart.

Another phase of the West Texas Gas Co.'s recent sales program has been the offer of an unusually liberal allowance on electric ranges traded in on the new cabinet types of insulated oven ranges.

Mid-West Natural in More Franchising Activity

Mid-West Natural Gas Co. has been granted franchises for the service of natural gas in Leigh, Creston, Humphrey, Madison, and Platte Center, Neb., and has applied for permits to serve gas in Scribner, Snyder, Dodge, Howells and Clarkson, Neb.

Fulton to Build Municipal Distribution System

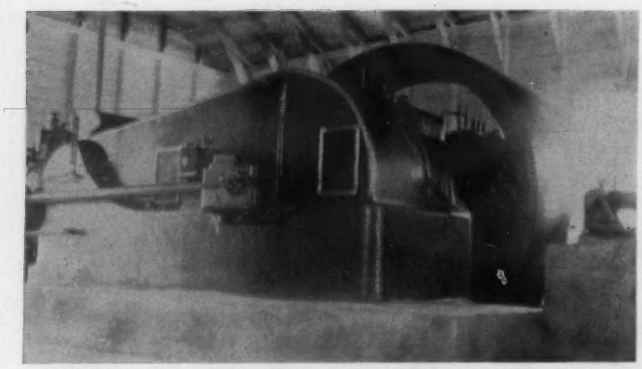
Citizens of Fulton, Mo., on March 3, voted to issue $80,000 in bonds to build a municipal gas distribution system, supply to come from the Missouri-Kansas Pipe Line Co.'s transmission line.

Ahlborn Transferred to Atchison; Naylor To Topeka

George H. Ahlborn, formerly manager of the Kansas Power & Light Co. in the Topeka District, has been transferred to Atchison as northeast Kansas district manager. Howard M. Naylor, construction engineer for the company, is now district manager at Topeka.

Southern Counties Remodels Santa Paula Compressor Plant

Southern Counties Gas Co., Los Angeles, Calif., has completed remodeling and enlarging its compressor station at Santa Paula, Calif., converting it to a main line booster station. Cost of the work was about $21,000.



170-190 H.P. Cooper-Bessemer gas engine driving 2-stage pump, 1200 g.p.m. against 300-ft. head, and a 56-K. V. A. generator. Installed under supervision of John H. Chase by Santa Maria Gas Co. for Atascadero Mutual Water Co., Atascadero, California. Photograph courtesy of Mr. Chase.

Developing Gas Engine Sales

(Continued from Page 32)

which would be accumulated if the payments were actually deposited in a savings bank. Interest should be figured just as though the payments were being deposited, for the reason that these charges are actually drawn for conducting business in which the gas engine is used, and these moneys are, in a real sense, earning interest. The privilege of using these funds for securing profits makes them grow just as they would grow in a savings bank.

One of the most glaring misstatements by the opponents of the gas engine is the assignment of a 10-year period as the normal life of a gas engine—an assumption which nothing can justify. Gas engines have been in practical use for 50 years, and experience during this time has conclusively demonstrated that, if they are properly cared for, their life is considerably beyond 25 years; in fact, their life is indefinite, as the major parts such as the bed plate, frame, fly wheels, crank shaft, and connecting rods, do not wear out, and the small or minor parts that are affected by wear are ordinarily taken care of by the account of maintenance or repairs. Table No. 3 shows the factor with which to multiply the installation cost to obtain the yearly depreciation charge:

TABLE NO. 3. YEARLY DEPRECIATION FACTOR

Years Depreciation	Rate of Interest 4%	5%	6%
10	.08329	.07950	.07587
15	.04994	.04634	.04296
20	.03358	.03024	.02718
25	.02401	.02095	.01823
30	.01783	.01505	.01265

Example: To accumulate $20,000 in 15 years at 6 per cent would require setting aside each year .04296 of $20,000, or $859.20.

While the life of a gas engine is far beyond 25 years, few business men would desire to keep their accounts open for so long a time, and it has, therefore, been the practice to consider a period of 15 or even 20 years in which to write off the gas engine investment.

For installations that are paid for out of savings, depreciation should not be charged when comparisons of operating cost are made, for the reason that there has been no capital expenditure by the user, to be provided for at the time the gas engine has reached the end of its useful life.

(3) *Insurance:* A gas engine itself is not a fire hazard. The only time that it is subject to damage from fire is when the fire originates in adjoining buildings. If the gas engine is located in a separate building, as in a pumping plant or a location where there is a fireproof wall between the engine room and the main building, there is absolutely no fire hazard, and, in consequence, no fire insurance is necessary. Where the gas engine user insists upon carrying fire insurance, the premium will not average over 1 per cent.

(4) *Taxes:* Taxes must be included. The amount of the taxes varies, depending upon the location of the gas engine installation. In the city, the taxes are usually higher than in the county. An allowance of 1 per cent on this is a very safe average, where the actual figures are not available.

Operating Charges

(1) *Fuel:* The cost of fuel can be determined readily from guarantees made by the gas engine manufacturer. The average gas engine should be able to develop a B.H.P. hour at, or near, full load, on not to exceed 10 cubic feet of gas, provided the gas has a calorific value of not less than 1000 B.t.u. per cubic foot. In making a comparison of the cost of operation between a gas engine and an electric motor, when the kw. hour consumption is known, it is an easy matter to convert the kw. hours to equivalent cubic feet of gas used, as follows:

A kw. hour is equivalent to 1.33 h.p. hours, inasmuch as the kw. hours always cover the input to the motor, and, therefore, include the motor losses, which are at least 10 per cent. It is evident that, for each kw. hour input to the motor, only 1.2 h.p. hour is the motor output, or useful work, which, at 10 cubic feet per h.p. hour, would be equivalent to 12 cubic feet of gas required by the gas engine to do the work of 1 kw. hour input to an electric motor.

Example: A motor using 70,000 kw. hours per month would require 70,000 x 12, or 840,000 cubic feet of gas in a gas engine to do the equivalent work, provided the gas is of at least 1000 B.t.u. value.

(2) *Lubricating Oil:* The amount of lubricating oil used by a gas engine is dependent upon the kind of oil used, and whether or not the used oil is reclaimed by filtering. A gas engine can be lubricated safely on the basis of 2000 h.p. hours of engine rating, costing not over 30 cents per gallon.

Example: A 150 h.p. engine operating 720 hours per month, or 108,000 h.p. hours, should use not to exceed 549 gallons of lubricating oil. Many gas engines use considerably less than this amount; in fact, about one-half.

(3) *Repairs or Maintenance:* If a gas engine operator will set aside, each year, for a maintenance fund, 2 per cent of the first cost of the gas engine installed, he will have more than sufficient to keep his gas engine in good repair. This covers the purchase of parts and the cost of their installation. The above 2 per cent covers engines operating continuously. Where the engine operation is seasonal, as in irrigation service, the cost of repairs should be proportionate.

(4) *Labor:* The mistaken idea persists that someone is required in constant attendance while a gas engine is in operation. This is not at all necessary, for the reason that practically everything about modern gas engines is automatic; they do not require skilled labor or expert supervision to operate them. All that is necessary is to see that the gas engine is supplied with lubricating oil. A gas engine is not trouble-free—nor is any other machinery—but when a gas engine gets to the point where adjustments or repairs are necessary, it usually indicates this in sufficient time so that the work can be done when most convenient. Inasmuch as it takes only a very small part of the operator's time to attend the gas engine—not sufficient to affect his routine work—it is not at all necessary to charge for labor on small installations. On larger installations this may not be the case. The number and location of the engines may necessitate some additional labor, which, of course, should be charged to gas engine operation.

Comparing Gas and Electric Costs

An analysis of comparative costs, as between electric and gas engine power, may be set forth as follows. We will take an arbitrary operating condition—say in the irrigation field—of a demand of 150 h. p. operating an average of 730 hours per month for 7 months during the irrigation period, which condition is not uncommon. Our comparisons will be:

1. Electric motor, 150 h. p with electrical energy at 1c per hw. hour.
2. Gas engine, 160 h. p. paid for in cash by the user, with gas at 30c per M cubic feet (1100 B.t.u.), and lubricating oil at 30c per gallon.
3. Gas engine, 160 h. p. paid for out of savings.
4. Gas engine, 160 h. p. supplied on a rental basis.

In order to obtain the full savings, we will show what the total expenditures are over a period of 15 years.

First Cost: The first cost of this equipment, installed, ready for operation, would not exceed:

150 h. p. Electric motor $1500.00
160 h. p. Gas engine 8000.00

1. Electric Motor:

Fixed Charges

Interest	6%
Depreciation	4.296%
Insurance	1%
Taxes	1%
Total	12.296% on $1500.00 = $184.44 per year

Energy Charge

150 h. p. output of motor with 90% motor efficiency = 124.3 kw. input × 730 hours = 90,739 kw. hours per month, or 635,173 kw. hours in 7 months, costing $6351.73.

Total Cost

Fixed charges	$ 184.44
Energy charges	6,351.73
Total—1 year	6,536.17
Total—15 years	$98,042.58

2. *Gas Engine (Paid for in cash by user)*
Fixed Charges
Interest 6%
Depreciation 4.296%
Insurance 1%
Taxes 1%
Total ..... 12.296% on $8000.00 = $983.68 per year
Operating Charges
Fuel: 150 h. p. output at 10 cubic feet per h. p. hour = 1500 cubic feet per hour × 730 hours = 1,095,000 cubic feet per month, or 7,665,000 cubic feet in 7 months, costing $2299.50.
Lubricating Oil: 160 h. p. × 730 hours = 116,800 h. p. hours = 60 gallons of lubricating oil, costing $18.00 per month, or $126.00 for 7 months.
Repairs: 2% on $8000.00 = $160.00.
Total Cost
Fixed charges ..... $ 983.68
Fuel 2,299.50
Lubricating oil 126.00
Repairs 160.00
Total—1 year 3,569.18
Total—15 years $53,537.79

3. *Gas Engine (Paid for out of savings)*
Fixed Charges
Insurance 1%
Taxes 1%
Total ..... 2% on $8,000.00 = $160.00.
Operating Charges
Fuel ..... $ 2,299.50
Lubricating oil 126.00
Repairs 160.00
Total ..... $ 2,585.50
Total Cost
Fixed charges ..... $ 160.00
Operating charges 2,585.50
Total—1 year ..... $ 2,745.50
Total—15 years $41,182.50
Plus cost of engine 8,000.00
Total net cost—15 years $49,182.50

4. *Gas Engine (Rental basis—$1,200.00 per year)*
Fixed Charges—NONE
Operating Charges
Fuel ..... $ 2,299.50
Lubricating oil 126.00
Repairs 160.00
Rental 1,200.00
Total—1 year ..... $ 3,785.50
Total—15 years $56,782.50

Table No. 4 gives a comparison of costs for electric motor, and for gas engine operation under the three above plans, for periods of 15 years and one year.

It is very evident from the above figures—which are based on conditions as they are actually found in the field—that the gas engine is by far the cheapest power. In no case have we figured labor, as there will be no more labor required to operate the gas engine than will be required to operate the electric motor.

In conclusion we would like once more to call attention to the following prerequisites to success in building gas engine load:

1. Send out experienced salesmen to obtain your gas engine business; it is cheaper in the long run.

2. When a customer is secured, take care of him; give him service—and you will be able to keep him.

3. If you must make up figures of comparison of operating cost to sell your customer, present figures that are correct, and then stay with them.

TABLE No. 4

Comparison		Total Cost 15 Years	Savings Gas Engine over Electric Motor 15 Years	1 Year
No. 1.	Electric Motor	$98,042.58		
No. 2	Gas Engine (Paid for in cash)	53,537.70	$44,504.88	$3,708.00
No. 3	Gas Engine (Paid for by savings)	49,182.50	48,860.08	4,071.00
No. 4	Gas Engine (Rental basis)	56,782.50	41,260.08	3,438.00

Longview-Kelso Water Gas Plant

(Continued from Page 29)

by 16-in. horizontal return tubular waste heat boiler built for 150 pounds working pressure is designed with a special type furnace having 48-in. space from the grates to the bottom of the boiler, and set in special designed steel casing. This boiler furnishes all steam for making gas as well as power for operating steam equipment in the plant.

One feature in this plant which makes for great economy, is the fact that on the back run of the operating cycle, the waste heat is taken direct to the fire box of the boiler, and this reduces the bituminous fuel consumption to less than 6 pounds of coal per thousand cubic feet of gas made.

After the bituminous coal is poured into the generator, the coal is heated and the gas taken off into the carburetor, which is filled with checker fire brick, having sufficient space between them to permit the air to be forced through. Secondary air is forced under the grates to blast the fire and the steam from the superheater up through the grates. Hydrogen and oxygen thus formed unite with blue gas given off from the coal to form carbureted water gas. In the same operation, in order to bring up the B.t.u. content to standard, oil is sprayed into the carburetor from the top and also combines with the gas, making approximately 525 B.t.u. gas.

After the carburetion process, the mixed gas proceeds down through the carburetor and up the superheater. The runs through the carburetor and superheater are reversed intermittently to thoroughly generate the gas.

After this process the gas passes through a hydraulic sealed tank half filled with water, which washes out some of the tar impurities. This seal is approximately 3 ft. 8-in. by 3-ft. 9-in. by 3-ft. 2-in. The heads and shells are of ¼-in. steel. A baffle plate of ¼-in. steel is used to separate the tar from the waste water.

The gas then passes through a 12-in. pipe into a scrubber tower just outside the main building which is 6 ft. in diameter and 20 ft. high, with a shell of ¼-in. steel plate, with a partition in the center for a removable top for removing the baffle trays. These baffle trays are of wood and staggered, and the gas passes up through one side and down through the other, making in all about 35 ft. of travel through the scrubber. From there it goes into the relief holder which holds 50,000 cubic feet, and is a single lift water seal holder. It is 59 ft. in diameter and 42 ft. high.

The tar from the operation of this plant is stored in the base of the relief holder. From the holder the gas is pumped by the compressor through three 10 ft. by 12 ft. purifiers built of ¼-in. steel and having trays. The first purifier contains wood shavings and removes more tar impurities from the gas, and the other two contain oxide of iron where sulphur and other impurities are removed. The gas is then ready for domestic consumption.

In order to maintain uniform and sufficient supply at all times, a compressor compresses this gas to seven large bullet shaped storage tanks each 11 ft. by 40 ft., on which is maintained from 30 to 60 pounds pressure, and which give high pressure storage facilities of around 100,000 cubic feet. A feature in the use of the high pressure storage is the fact that any tar or other impurities which get by the scrubbers and purifiers is dropped in the high pressure storage tanks, through the compression and expansion, and is then drained from the high pressure tanks. This keeps any tar deposits from the distribution lines.

After three months operation, we have not the slightest showing of tar deposits in the large drip provided on the outlet of the high pressure tanks into the distribution mains.

The compressor is an Ingersoll-Rand, 12-in. by 13-in. by 12-in. in size, with piston displacement of 750 cu. ft. per minute at 275 R.P.M. The pressure is reduced from the high pressure storage from 2 to 5 pounds into the distribution system with Emco 4-in. by 4-in. pressure regulators.

The distribution systems are high pressure systems and each individual consumer is served through small house regulators which reduce the pressure to approximately 4-in. water for consumer at the appliance. The mains are all constructed of plain end line pipe, welded and with Dresser connections. Consideration was given in the construction to the possibility that natural gas might some day be available, and the system was so designed as to be suitable without any alterations. The mains are all coated with bitumastic enamel, and the town is well covered with the system so that very few extensions will have to be made for future consumers.

The headquarters for the Washington district is at Longview, Wash.

Pecos Valley Gas Co. Moves Carlsbad Office

Offices of the Pecos Valley Gas Co., Carlsbad, N.M., were moved in March to the Carlsbad National Bank Building from the old location at 110 Canyon St.

Applies to Serve Dearing, Kan.

Meredith C. Crane has applied for a franchise to serve Deering, Kan., with gas, supply to come from the Crane wells, north of Dearing.

The Carquinez Straits Crossing

(Continued from Page 35)

the Sacramento Valley. The heavy moisture content of the air made the metal work of the bridge and the pipe extremely slippery, especially in the early morning.

The two 12-inch lines across the bridge, tying into the 16-inch lines on both ends, are sectionalized by four electrically operated, remote controlled valves. In addition, there is an electrically operated blow-off valve on each line. All of these valves are operated from a central switch and indicating board in the toll house so that in case of a failure or accident to either line the gas can be shut off and the line purged from that one central point. In order to accomplish this it was necessary to run over 40,000 feet of wire. In the control house the electric lights indicate the position of each valve. The two lines can be sectionalized individually or together and an interlocking device is so arranged that the blow-off valves cannot be opened until the sectionalizing valves are closed. Both blow-off valves tie into a common blow-off line which is carried to the top of a high hill on the northwest side of the bridge.

In order to take care of the expansion and contraction of the bridge which is taken up at three expansion joints, each pipe line includes three loops or expansion bends. These bends are horizontal loops of 9 feet radius, one at either end, where the bridge itself is supported on rocker-arms, and two pairs at the bridge expansion joints. These loops are supported on brackets and rollers and extend under the floor of the roadway. The line is mounted on the upper support of the double support brackets fastened to the main bridge channels. During construction temporary rollers were used on each of these support brackets in order that the pipe might be rotated for welding. After completion the rollers were removed and the line fastened by a wide U-band and left resting upon oil-impregnated wooden blocks.

The photographs show a double line, the lower pipe being the cast iron water main of the California-Hawaiian Sugar Co.

The main gas lines were hoisted in 30-foot sections over the side where the welders tied them into position. No superstructure was required. The placing of the expansion loops and brackets, however, required the hanging of a temporary superstructure from the bridge.

While these permanent lines were being constructed, gas was conveyed across the bridge in a temporary 6-inch line laid on the pedestrian walks and fastened to the railing. This line was later cut up with acetylene and removed.

Kansas City Househeating Records

By ROY B. MUNROE

Industrial Engineer
Kansas City Gas Company

THE Kansas City Gas Co., Kansas City, Mo., commenced an extensive house heating campaign in February, 1929. During the calendar year 1929, new business representatives, under the direction of M. B. Buckley, new business manager, sold 6,500 all gas central house heating installations. This work was carried over into 1930 and for the calendar year 1930 these same men sold 3,500 more all gas house heating installations. This tremendous house heating load has proven very beneficial to the company as a whole and may be said to be the result of numerous merchandising campaigns such as that outlined below.

In June, 1930, it was annonunced that three sales supervisors and three new business representatives were to spend two weeks the following December visiting several factories where gas burning equipment was manufactured. These six men were to be decided upon from the results of a five-months merchandising campaign. This campaign was to be carried out by 56 territory representatives divided into five small crews of eight men each and one double crew of 16 men.

A contest was arranged between the six crews and the rules were drawn. As the company was very anxious to increase its house heating load, this was made the most important factor. The six crew supervisors decided on the following principles upon which the contest should be based:

1. The crew having the largest number of central house heating installations would receive 200 points and that number of installations considered as 100 per cent. Each of the five other crews was to receive a number of points in a direct ratio to its percentages.

2. The crew having the largest sum of dollars worth of gas burning equipment installed was to receive 100 points, the other crew would receive points in a direct ratio to its percentage of what the leading crew had.

3. The crew selling its stock quota the greatest number of times during the November customer ownership campaign was to receive 100 points and the other crews would receive points in a direct ratio to their percentage of the leading crew.

The salesmen in each crew were to be contesting on a similar arrangement; thus there were seven contests, namely, one between the crews and one in each crew.

The three leading crews were to send their supervisor and the highest men as winners of the coveted trip.

The contest was very close and up to the last month Messers Edmonds and Evans, supervisor and high men of crew "A," were the only two men who could really feel that they would win the trip. Mr. Edmonds' crew "A" was a double crew with 16 representatives and his men finished first in all three phases of the contest.

During the five months of this contest these 56 representatives sold and placed into operation along the Kansas City Gas Co.'s mains, gas fired equipment totaling $355,000, including 1,654 all gas house heating installations. During the November customer ownership campaign, Nov. 10 to 20, these men sold Cities Service securities totaling slightly over $200,000.

Geo. Evans of crew "A" was high man with installations totaling slightly over $16,000 and including 75 all gas house heating installations.

Contests of this nature with various other prizes and bonuses have enabled the new business department to sell and execute 10,000 all gas house heating installations since February, 1929, when the extensive house heating program was first started. There are now over 14,000 houses in Kansas City, Mo., that use gas exclusively for heating purposes. This is equivalent to one out of every 5½ houses.

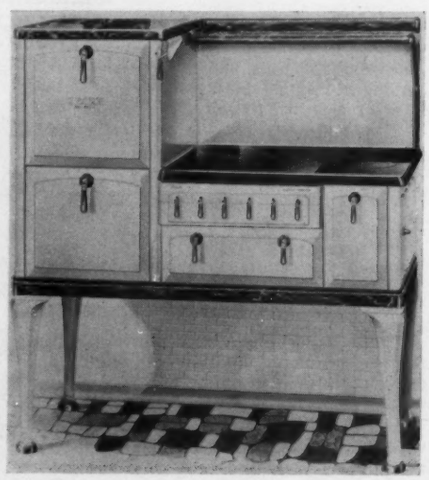
Compensation Plan for Representatives

Straight commission on net installations.
16 Per cent on first $1000.
18 Per cent on next $1000.
20 Per cent on all over $2000.
with $100 drawing account cumulative.

Hammer-Bray Announces "Senorita" Stove Line

Hammer-Bray Co., stove manufacturer of Oakland, Calif., in March announced a new line of Spark Lid-top insulated-oven gas stoves. The line has been christened the "Senorita," the new stoves embodying an application of the Spanish motif of art in their design and finish.

Spark "Senorita" stoves are constructed about a heavy, oversize structural steel frame and have insulated ovens with ventilated "even-heat." The kitchen heater model retains the trash burner with the patented full-length extension gas burner, which makes it



possible to cook with gas on the two holes over this section. This is in addition to the full-length trash and kindler burner. The lid-top is of one piece construction. New giant speed burners are featured.

An enclosed manifold is provided which is said to prevent cooking heat from reaching the valve handles and to make cooking a comfortable task.

The stove is provided in several enamel finishes and the oven top, shelf and stove base have a black marble finish.

All corners are rounded or beveled and crevices avoided.

Spark "Senorita" is made in both straight gas and trash burner models.

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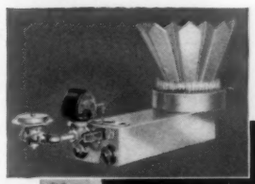

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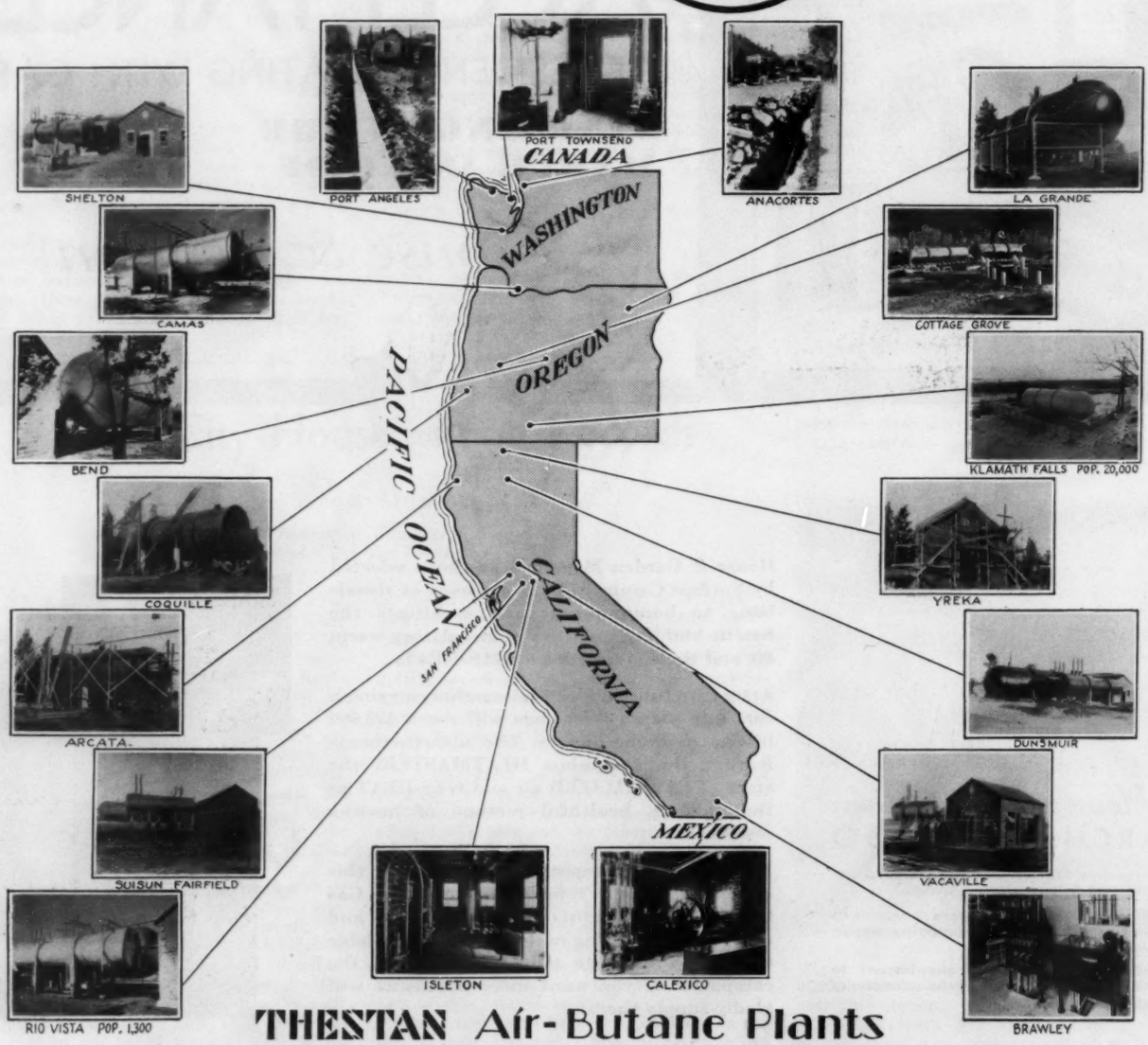

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BUTANE - PROPANE NEWS
Covering Liquefied Petroleum Gas Service

Technical Groundwork Laid *for* Wide Utilization *by* Gas Utilities

By O. M. SETRUM
Manager
Gas Manufacturing Division
Philfuels Company

O. M. SETRUM'S discussion of liquefied petroleum gases, prepared for the 13th Annual Convention of the Oklahoma Utilities Association, was an outstanding feature on the Gas Division program. The paper was read before the Gas Division on March 11, and in Mr. Setrum's absence was delivered by T. W. Legatski, assistant director of research for the Philfeuls Co.

O. M. Setrum

The following extracts from the paper treat in some detail of phases which have received little discussion—particularly as applies to central plant investments and operating costs.—EDITOR.

THE two most important liquefied petroleum gases are propane and butane, and they are the predominating components of the various established grades of liquefied petroleum gases. These compounds belong to the paraffin series of hydrocarbons. While normally gases, these compounds can be easily liquefied under nominal pressure and ordinary temperature conditions.

The chief source of these products at the present time is the natural gasoline industry, although large amounts are also available from the cracking processes at petroleum refineries. The natural gasoline industry with existing compression, absorption and rectification equipment, can in many cases produce specification liquefied gases at a lower cost than can the refineries. This is especially true because of the fact that elimination of all of the propane and reduction in the butane content of natural gasoline results in a superior blending material for motor fuel.

The greater percentage of natural gasoline produced today is made by the absorption method, in which the various hydrocarbons comprising natural gasoline are absorbed from the natural gas through the use of an absorption oil. In removing the natural gasoline from the gas, considerable quantities of the lighter hydrocarbons are also removed. By varying pressures and oil rates, the amount of propane and butane extracted from natural gas can be controlled.

By rectification, it is possible through proper control of temperature and pressure conditions to segregate these various compounds. The degree to which this can be carried out is limited only by economic factors. It is entirely possible by means of the modern rectifying tower to produce a product which has a boiling range of only 2° or 3°, but for commercial purposes, it is not always necessary to fractionate so closely. For instance, commercial butane has a boiling range of from 14° to 32°F., and consists of approximately 95 per cent butane (both iso and normal), the remainder being primarily propane.

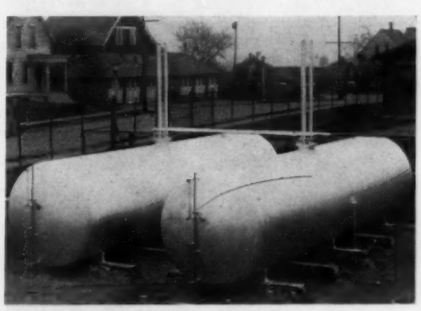
A careful survey of the potential supply shows that there are available some 13,000,000 gallons of propane and butane per day from the natural gasoline industry. About 1,500,000 gallons can be produced in the process of preparing natural gasoline for the market. Of this amount, a conservative estimate is that 50 per cent would be costly to produce, due to the fact that it occurs at small properties at which it would not be feasible to install the necessary rectifying equipment. A conservative estimate would be that at the present time there are over 750,000 gallons daily available whenever the market justifies. Consequently, it is very evident that the problem is not one of production, but rather one of creating outlets for these materials by the development of new and existing markets.

Due to the fact that these products have a much higher vapor pressure than gasoline, existing equipment for the storage, transportation and handling could not be utilized. New developments have been made both in storage and tank car equipment so that it is possible to store and transport these products with safety and with no loss.

Considerable work has been done with the various regulatory bodies in securing a uniform code regarding the storage and handling of both propane and butane.

The majority of freight associations have placed these commodities in the refined oil classification which results in a considerable reduction in the cost of transportation.

Another method of transportation is by means of pipe lines. The Phillips Petroleum Co.'s 8-inch gasoline line from Borger, Texas, to St. Louis, will have some 10 pumping stations. The pumps at these stations will be driven by gas fueled engines operating on butane. Storage will be provided for butane at each of these stations and the liquid butane will be "slugged" through the line. Were this line used entirely for carrying butane, it would have a daily capacity in liquid butane equivalent to approximately 143 million feet of natural gas on a thermal basis.



Butane storage tanks, 10 feet by 40 feet, on typical Philfuels butane-air plant installation.

The possibility of shipment by tankers and steamships is being investigated at the present time.

A large amount of work has been done in developing not only mechanical equipment for the manufacture, storing, transportation and handling of these products, but also in the development of various methods of utilization, and practically every step from the original production to the ultimate utilization has undergone careful study and research.

Central Plant Distribution of Liquefied Petroleum Gases

(a) Distribution of Undiluted Propane: The undiluted propane vapor (2550 B.t.u. per cu. ft.) is piped directly from the top of the liquid storage tank through pressure regulators into a pipe line distribution system and to the point of consumption. This would be practically equivalent to a natural gas well at the property and possess the advantage that the potential supply of gas can always be maintained by tank car shipments of propane.

The low capital investment required for plant equipment, the elimination of practically all power and maintenance costs, and the reduction of labor costs to a minimum, make this method of special interest when the total number of customers and the daily sendout are limited. The fuel cost per M will be higher than with butane-air carburetion on account of the price differential between the two products. Due to the fact that butane is not self-vaporizing at temperatures

below 26°F., it cannot be used in the undiluted form. This higher fuel cost for propane will be compensated for, in situations as described before by the reduction in fixed charges and operating costs. The equipment for a plant of this kind would consist essentially of a liquid storage tank and a regulator, the gas to be piped directly into the distribution system.

With newer and more improved methods of construction, distribution systems installed will reduce distribution losses to such an extent that this factor need not be feared.

Efficient and dependable meters for measuring small volumes are available. It will be necessary either to sell the propane distributed in this manner on a thermal basis or to employ a differential scale on the meter, reading in terms of gas of a commonly accepted calorific value standard.

(b) Butane-Air Plants (Philfuels Process of Gas Manufacture): The process consists essentially in diluting a high calorific liquefied petroleum gas with air or some non-combustible inert gas to obtain a mixed gas of the desired calorific value.

Due to the fact that the cost of butane and also the liquid storage installation is less than that of propane, butane is used.

The method of dilution or mixing these gases most generally employed is that of a positive proportioning device, employing a variable orifice with a fixed differential. This method of proportioning has the advantage of low initial investment, positive action, flexibility under variable load, low maintenance, and can be adapted for either low or high pressure systems. Some of the other methods available for this process are:

(a) Fixed orifice, fixed differential, for constant loads.

(b) Calorimetric devices, where the ratio between butane vapor and air is maintained by electrical and mechanical controls actuated by calorimetric means.

(c) Metered liquid injection type.

(d) Displacement meters linked together. One gallon of liquid butane (Grade G-4) when vaporized produces 32 cubic feet of butane vapor having a calorific value of 3200 B.t.u. per cu. ft. and a specific gravity of 1.95. As this product is made to pass rigid specifications these properties are constant and it is possible to calculate accurately the calorific value and specific gravity of any mixture of butane vapor and air.

Liquid butane is shipped in Class 104-A tank cars of approximately 10,250 gallons loaded capacity. These tanks are insulated and are equipped with special unloading equipment, check valves, eduction lines, gauging device, thermometer well and safety relief valves. The transportation and handling of the liquefied petroleum gases does not offer any more hazard than does motor fuels or gasoline. Regulations of the I.C.C. and the Bureau of Explosives cover the handling and shipping of these commodities.

The liquid fuel is unloaded into the plant storage tank. The storage facilities should be such that an entire tank car can be unloaded at one time. These plant storage tanks are designed according to A.S.M.E. code and built for 80 pounds working pressure. They need not be insulated and can be either above ground or buried, depending upon local regulations. The unloading of tank car and transfer of butane can be accomplished by pumps; however, in nearly all instances the pressure differential method is employed as it obviates the installation and maintenance of pumps. By maintaining a pressure differential of from 5 to 10 pounds per sq. in. between the pressure on the tank car and the storage tank the liquid can be readily transferred even in the coldest weather, as the viscosity is extremely low. When high pressure gas storage is employed this can be piped to the vapor space above the liquid to maintain the necessary differential, the pressure on the storage tank being kept from equalizing by drawing the vapors off into the proportioning machine.

As the vapor pressure of the liquid butane is a direct function of its temperature, the tank car pressure can be maintained to effectively transfer the contents by heating the liquid by means of coils with which these cars are equipped, using either hot water or steam. In the event neither of these means are available a small auxiliary gas compressor can be employed. From the storage tank the butane liquid is transferred by pressure, through a liquid regulator which maintains a constant reduced pressure of approximately 5 pounds on the liquid entering the vaporizer, which consists of a multitubular heat exchanger. The hot water or steam used for vaporization passes through the tubes and the liquid butane around the tubes. Flash vaporization takes place and the butane is thus converted from a liquid to a gaseous state. The latent heat of vaporization is 830 B.t.u. per gallon and a hot water storage heater can be used to supply this heat. This heater should have sufficient capacity to supply the heat required and should be provided with thermostatic control so as to maintain a uniform vapor temperature. During the summer months the vapor may be drawn directly from the liquid storage tank, thus eliminating the necessity of operating the hot water heater.

The butane vapor leaving the vaporizer is reduced to approximately 6 inches of water by means of a pressure regulator. This vapor is then metered, a thermometer being provided so that the volume can be corrected for both temperature and pressure. This reading serves as a double check first on the amount of liquid butane used, as shown by the liquid gauges on the storage tank and also on the total volume of butane gas as shown by the station meter. After being metered the vapor passes through the regulator of the proportioning valve, which reduces the pressure to atmospheric. The proportioning valve placed on the suction line of blower or compressor mixes the butane vapor with air in any desired ratio, depending upon the calorific value required for the finished gas. The valve is adjusted properly at the start of operations and is automatic in its operation in maintaining the proper mixture. Once the machine is set for any definite ratio it does not require subsequent adjustment.

Manual control of the equipment may be used, but automatic or semi-automatic control is recommended. Control of the proportioning machines by means of a time switch enables the machine to operate at predetermined intervals. The compressor is controlled by a pressure switch which starts compressor motor at minimum pressure and stops it when the desired maximum pressure is reached.

As the calorific value of the gas is a function of the percentage of butane vapor upon which the specific gravity of the mixture is also dependent, either a recording thermal conductivity cell or a gravitometer can be used as a recording calorimeter.

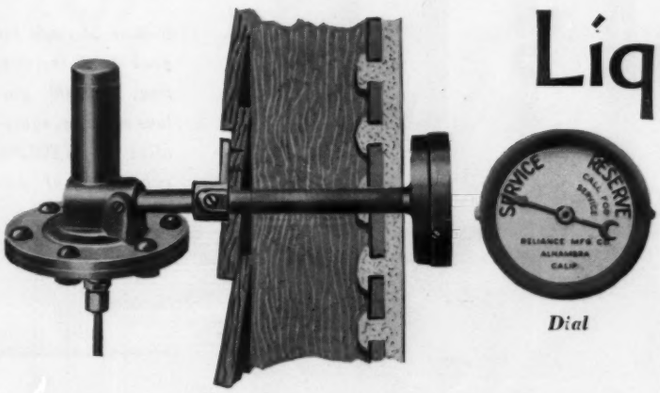
This recording device is provided with electrical contacts which can be set between any desired limits so that if for any reason the calorific value of the butane-air gas varies beyond these limits the proportioning equipment is automatically shut down.

When this process was first introduced there was some question among gas engineers as to the feasibility of storing this gas under high pressure.

The dew point of a mixed gas is dependent upon the condensation points of the components and also the relative percentages present (Law of partial pressures). In the case of butane gas, a binary mixture of air which can be in this instance considered non-condensible, and butane vapor whose vapor pressure temperature relations have been carefully calculated and checked by laboratory tests, we can calculate the exact condensation temperature, knowing the calorific value of the gas and the pressure to which it is subjected. These calculated values have been checked on actual mixtures to verify the calculated data. The dew point of a 530 B.t.u. gas at 40 lbs. gauge pressure is 2°F., at 20 lbs. gauge —15°F., and at 5 lbs. gauge —35°F. As the pressure carried on distribution systems in very few instances exceeds 10 lbs. there is no possibility of partial condensation in the distribution system even in the far northern sections, inasmuch as ground temperatures rarely decrease to any point comparable with low winter atmospheric temperatures. When it is necessary to store butane gas under high pressure, 30-36 pounds, subjected to sub-zero atmospheric conditions, two alternative means are available to prevent partial con-

Showing proportioning valves, surge tank and compressors, in a typical Philfuels butane-air plant.

RELIANCE



Dial

Indicator Assembly

Liquid Petroleum Gas Regulators

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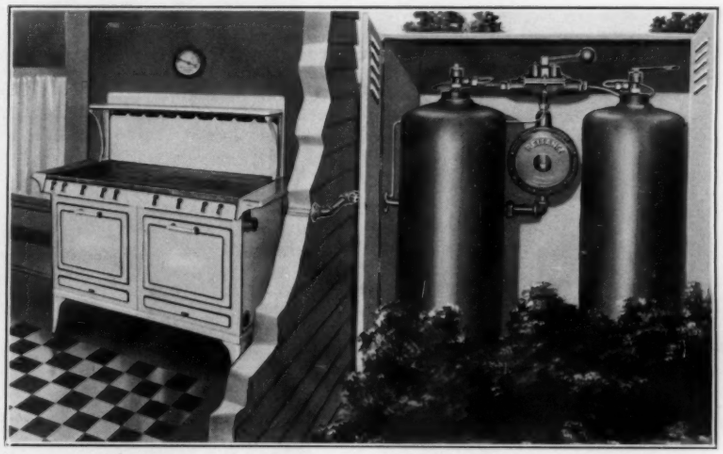

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- Indicates cylinder operating
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This type of control makes it extremely convenient for the customer and never allows him to be out of gas and insures a service as constant and dependable as any natural or manufactured gas company can offer their customers.

The type "M" regulator is in reality a duplex regulator, reducing extremely high pressures encountered in the service cylinder when first installed, to a uniform outlet pressure varying from three to six pounds, thereby enabling the secondary, or Type "B" regulator, to work under normal, reasonable conditions at all times, insuring uninterrupted service to the appliances without pressure fluctuations.

Type M and B Regulator Assembly

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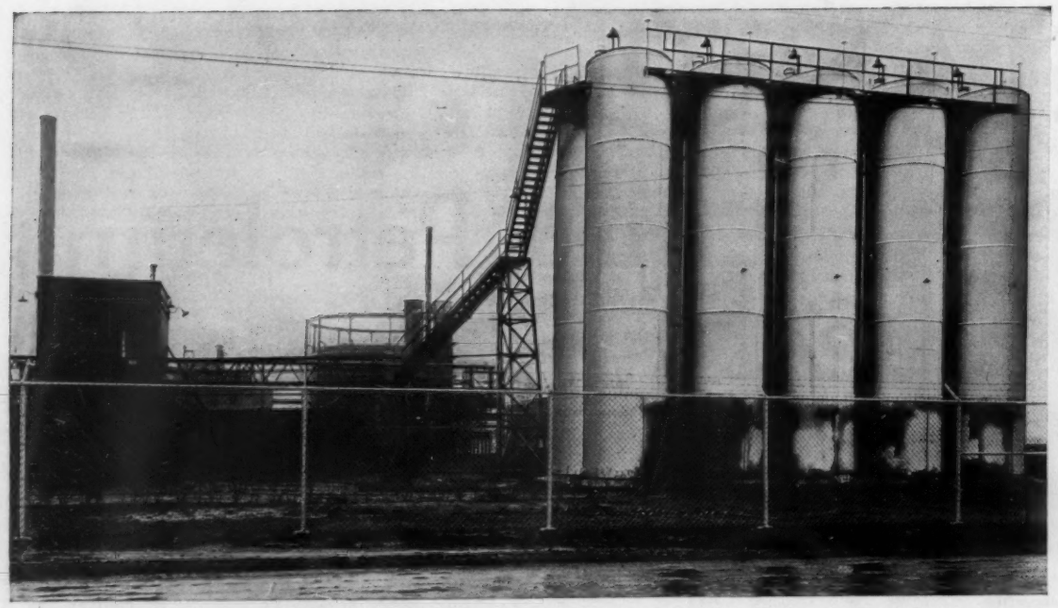
Dallas, Texas



Butane storage for peak load installation, 150,000 gallons capacity, equivalent to 13,900,000 cubic feet of natural gas.

densation, first by maintaining a higher temperature on the gas by insulating the storage tank or by a heating coil, or by installing the storage tank so as to be partially buried; second, by substituting a mixture of propane and butane as the base material. The dew point of propane vapor at 30 inches of mercury is —44°F., as compared to 26°F. for undiluted butane vapor. Either method offers a ready solution of this problem.

The rate of flame propagation of butane-air gas is practically the same as that of natural gas. On account of the higher specific gravity it will be necessary to change or adjust the spud orifice. Due to the fact that the gas contains approximately 15 per cent of the air required for complete combustion, the air shutter will have to be adjusted from the normal setting. Outside of these two changes none other are required for appliances designed for natural gas.

There are no special problems in the operation of these plants. The capital investment of a plant of this type is small compared to that of the conventional gas plant. The plant site need not be large, but should be so situated that it is accessible to a railway siding for delivery of fuel. The floor space required for the building is small, 24 ft. by 24 ft. being ample for both gas making equipment and work shop. The equipment required can be grouped into six units. Approximate costs are as follows:

Unit I.	Liquid storage (15,000 gallon tank complete with valves, fittings and piers)	$2,090
Unit II.	Vaporizing equipment (Vaporizer regulators, hot water heater and fittings)	550
Unit III.	Carbureting equipment (6,000 cu. ft. hour) Machine and motor	1,500
Unit IV.	Control equipment (Station meter, recording calorimeter, and electrical control equipment)	1,090
Unit V.	Compression Equipment (1 compressor, meter and fittings)	950
Unit VI	Gas storage equipment. (16,000 cu. ft. at 60 lbs. pressure)	2,680
	Total	$8,860

The above costs do not include freight charges, but as the major freight charges are on the liquid and gas storage tank, which can, in most instances, be fabricated at points nearby, the freight cost should not exceed $500. The labor cost of installation is not excessive, as the greater part of the equipment is of such nature that it can be erected with a minimum of labor.

Due to the fact that the majority of equipment is over capacity, the cost of increasing the plant capacity is not in direct proportion to the cost of a single unit. For instance, to provide dual carbureting and compression equipment or to double the gas storage would increase the total cost approximately $1,500 to $4,000, depending upon the equipment used, thus making the total cost of the plant equipment with a maximum hourly production capacity of 12-14 M per hour from $10,000 to $13,000.

The distribution systems used are in practically all cases of the semi-high pressure type with individual service regulators, being very similar to the distribution systems used for natural gas service.

Manufacturing Costs

The cost of gas delivered in the holder is dependent upon a number of factors. The majority of these factors can be estimated with a high degree of accuracy. It is interesting to know that preliminary estimates of this kind have been confirmed by actual operating data obtained at a number of plants. The chief cost factors are:

Cost of Butane: Prices of butane are based on a schedule which provides reductions with increased quantities purchased. This price ranges from $.04 to $.0275 per gallon F.O.B. Group III. Utility companies operating a number of plants of this type may take advantage of this schedule with the consequent reduction in fuel costs at all of their plants. On purchases of 60,000 to 80,000 gallons of butane per month, the price is reduced to $.031 per gallon F.O.B. Group III. This reduces the manufacturing cost of 530 B.t.u. gas approximately 4.66c per M. This saving at several plants is considerable and is an important advantage of the large scale use of butane.

Freight Rates: The freight rates on liquefied petroleum gases are the same as those for refined oils. Present rates per gallon are as follows from Group III, to

Kansas City	$.0168
St. Louis	.0198
Chicago	.0238

Power Cost: This depends upon the cost of electrical energy and the method of operation employed. Approximately 4/10 of a kw. hr. is required per M to operate a proportioning machine delivering gas at a maximum pressure of 3 lbs. To compress gas to 30 lbs. requires approximately 1.5 kw. hr. per M. When electric power rates are excessive it is entirely feasible and more economical to operate gas fueled engines.

Labor Costs: This is reduced to a minimum as the entire process is automatic. Not over two or three hours per day of a man's time should be required.

Heating: A certain amount of heat is required to vaporize the butane during the fall and winter months. During the warmer part of the year this is not necessary. It is necessary to keep the temperature of the plant above freezing during operation but as the building is small this cost is not excessive.

Maintenance: This cost is very low, due to the fact that repairs and replacements are negligible.

Summary of Costs: The total cost of gas would be as follows, assuming a 530 B.t.u. gas, price of butane 4c per gallon, and an average freight rate of 2c per gallon, and electrical energy at 3c per kw. hr.:

Fuel Cost (5.175 gallons at $.06 F.O.B. plant)	$.3105
Power Cost (assume all gas compressed to 30 lbs.)	.0450
Labor Cost (based on a 50,000 daily sendout)	.0300
Vaporizing and heating building	.0200
Maintenance	.0200
Total Cost	$.4255

To the above operating costs must be added fixed charges on investment in plant and dis-

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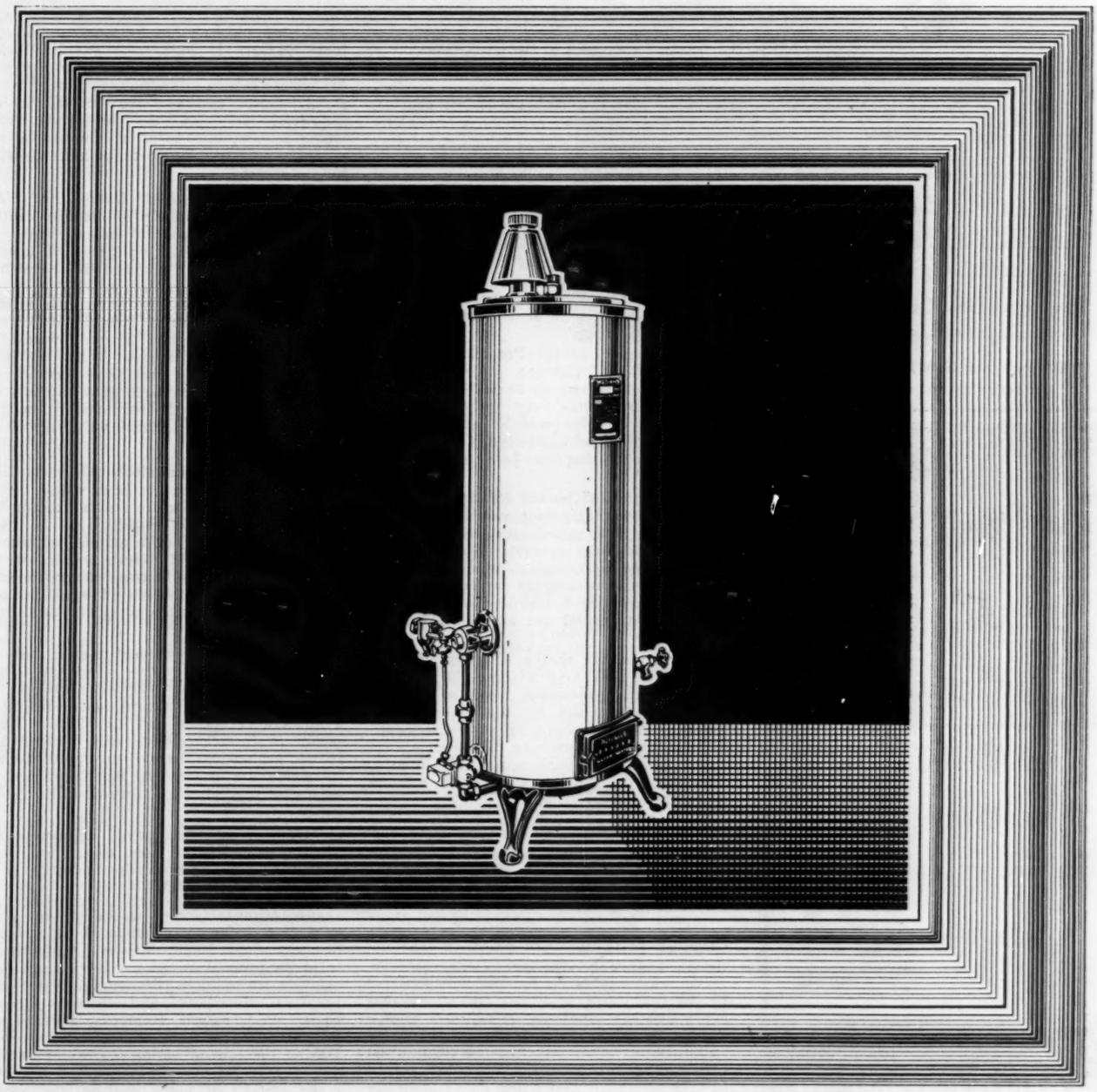
SELF-ACTION STORAGE GAS WATER HEATER



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tribution system together with unaccounted for gas losses, sales and management expenses. Due to the decreased cost of the plant equipment, the reduction in fixed charges is such that they will more than compensate for the manufacturing costs, so that the actual cost of gas delivered to customer will be lower than possible with other types of manufacture for plants where the daily sendout is under 150,000.

The minimum number of services required for the profitable operation of a plant of this kind will vary depending upon manufacturing costs and cost of installations. A conservative estimate would be 350 services.

The Use of Butane For Peak Loads

The increased consumption of gas during the past few years, due to the increased use for industrial and house heating purposes, makes the problem of meeting peak loads one of serious importance to the gas industry.

The ability to store gas in holders enables the utilities to operate at an hourly production lower than the maximum hourly sendout. The increase in holder capacity is limited by certain cost factors, beyond which it becomes more economical to install additional generating equipment or, in the case of natural gas, additional transmission lines, hence a more satisfactory means of meeting these high peaks has long been sought. The total volume of peak load gas is in most instances only a small percentage of the total sendout, consequently, the production of this peak load gas involves excessive fixed carrying charges due to the equipment or transmission lines required.

H. B. Nagler, of the Peoples Gas Light and Coke Co. of Chicago, chairman of the A.G.A. sub-committee on Peak Load Production Equipment, has very aptly given the Gas Industry's viewpoint in his statement, "The problem is primarily one of low investment costs, operating costs being of secondary importance."

The low cost of butane storage, handling and utilization equipment resulting in low depreciation and maintenance costs, makes the use of butane a valuable means of meeting these seasonal as well as periodical peaks. Aside from the advantages derived from low investment cost, the flexibility of the fuel and the range of control are additional desired features.

It is imperative that a close examination be made of peak load mixtures in order to determine the volumetric increase possible without the necessity for appliance adjustments. The limitations of satisfactory appliance operation determine the possible variation of the gas distributed which, in turn, determines the volumetric increase possible for mixtures of given gas.

The subject of mixed gases is receiving a great amount of attention at the present time, and many of our former ideas have been changed. It is generally assumed that the following variations are allowable without necessitating appliance adjustment.

(1) A downward variation in calorific value of 10-15 per cent provided that the specific gravity is constant.

(2) A variation in specific gravity from 10 per cent below to 20 per cent above that for which the appliance is adjusted assuming a constant thermal value.

(3) A variation in chemical composition such that ignition velocities are not decreased to such an extent that flame blows from the ports.

Recent investigations indicate that increasing the calorific value allows a considerable greater increase in the specific gravity without appliance adjustment and that it is possible to use mixtures of a much higher specific gravity than was previously considered possible.

There are a number of methods whereby butane can be utilized, the method employed depending largely upon such factors as the volume of peak gas required, length of peak period, whether straight natural gas or mixed gas is distributed, the thermal value, character of gas load, relative costs, etc.

These methods are as follows:

(a) Use of Butane for Industrial Fuel: Where there is a considerable industrial gas load, the problem is easily solved by diverting as much of this load as may be necessary to relieve the peak and substituting butane. The utilization of butane for industrial use entails a minimum of equipment and appliance adjustment.

A similar means has been employed for several years at an eastern city. When the supply of natural gas became insufficient, large industrial loads were supplied with water gas, thus conserving the natural gas for domestic use. Inasmuch as the butane could be used undiluted for the majority of industrial processes, the investment cost would be very low, as all that would be required would be storage tanks and vaporizing equipment.

(b) Mixing Undiluted Butane and Natural Gas: It is possible by the addition of undiluted butane vapor to increase the volume of natural gas (.65 sp. gr.—1100 B.t.u.) approximately 11 per cent and still be within the 20 per cent allowable gravity increase. Due to the fact that this mixed gas would have a calorific value of approximately 1300 B.t.u., the total thermal increase would in reality be over 30 per cent. When the total peak gas required is small, this method can be used. The investment of equipment is minimum, although the fuel cost of the gas due to its increased thermal value would be high.

(c) Mixing a Butane-Air Mixture and Natural Gas: When the peak volume is of any magnitude, it is more feasible to employ a butane-air mixture of 1100 B.t.u. Such a gas would require 10.72 gallons of butane per M. cu. ft. With such a mixture it would be possible to increase the volume 30 per cent. The fuel cost per M would be considerably less than employing the undiluted butane vapor.

In the event a percentage greater than 30 per cent were required, it would be necessary to increase the thermal value of the butane-air mixture. Calculations show that a mixture of butane and air of 1800 B.t.u. would be interchangeable with natural gas in all proportions as far as appliance adjustments are concerned, thus providing a means of supplying gas service in an emergency.

Various tried and proved equipment for mixing, proportioning and controlling these gases are available to the industry at a moderate cost.

(d) Manufactured Gas, Butane and Natural Gas: The introduction of natural gas to many of our larger cities will undoubtedly be in the form of mixed gas, having a higher calorific value than the manufactured gas previously distributed, and sold on a thermal basis. At Louisville, Kentucky, a mixed gas of this nature has been used for several years. During the summer months, straight natural gas of 1150 B.t.u. is distributed. Due to the large amount of house heating, the winter requirements are nearly four times the normal summer load and the amount of natural gas available is insufficient. Water gas is used to give the additional volume, the calorific value of the mixed gas being 850 B.t.u. The water gas generators were unable to

furnish sufficient gas to meet extreme peak conditions and at the same time meet the 850 calorific standard; the volume of 550 B.t.u. gas required being such that when mixed with the 1150 B.t.u. natural, the mixed gas would fall below the required minimum. Rather than providing additional generator capacity, it was decided to employ butane. Storage for 150,000 gallons was installed, together with the necessary handling equipment. The increased capacity required was obtained by increasing the amount of blow run, oil being used on the back run and recarbureting this gas with butane to such a calorific value that when mixed with the natural gas, the resultant gas would still be over the 850 B.t.u. minimum. In this connection it is interesting to know that by means of butane it has been possible to produce a carbureted water gas of 850 B.t.u. to take care of an emergency load caused by a break in the natural gas transmission line.

Since its erection in 1928, this installation has proven very satisfactory. No difficulties in appliance operation have been experienced and during the plant's operation, satisfactory results have been obtained. The cost of this installation was under $50,000, and it provides a gas reserve equivalent to 13,900 M cu. ft. of natural gas.

(e) Reforming and Gas Cracking: Reforming butane offers a large interesting field and opens up many possibilities. The method of reforming varies. In some instances the gas is passed through an incandescent bed of coal or coke; in others the cracking or reforming is accomplished in tubes with the heat supplied from outside means; in others, the heat is obtained by partial combustion. The chief interest to the gas industry is the fact that by reforming it is possible to produce a gas of a considerable range in gravity and calorific values, as well as chemical composition, which makes it possible to blend it with other gases in any proportion.

Standby Use

One of the bugaboos ever threatening the gas utilities is the fear of interrupted gas service. Even though the probability of a break in transmission lines is remote, there is always a possibility that it may occur.

Butane, on account of its high thermal value, offers possibilities in furnishing a gas standby reserve.

A 10 ft. x 40 ft. storage tank has a capacity of 19,400 cu. ft. of natural gas at 75 lbs. gauge pressure, the total thermal content of this volume of 1100 B.t.u. gas being 21,340,000 B.t.u. This same storage tank will hold 24,800 gallons of butane or 2,539,520,000 B.t.u., which is equivalent to 2,539 M cu. ft. of natural gas. On a thermal basis, the storage capacity of butane is 136 times as great as that of natural gas at 75 lbs. pressure.

Using cylindrical storage tanks of the size mentioned above, the cost of storing the butane equivalent to 1 M cu. ft. of natural gas is $0.90, as compared to $122.00 for the storage of natural gas. Using larger storage tanks, these figures would be reduced, although the ratio between the two would be the same.

Table No. 1 gives the delivered cost of butane per 1,000,000 B.t.u. (1 M cu. ft. 1000 B.t.u. natural gas) at various prices F.O.B. source, and freight rates as listed.

Several large manufacturing companies using natural gas have recently installed butane storage as a standby to insure complete assurance in the continuity of an adequate fuel supply.

TABLE NO. 1

Butane	Freight Rate Per Gallon			
F.O.B. Source	$0.010	$0.020	$0.025	$0.030
$0.02	0.293	0.390	0.440	0.488
.025	.342	.440	.488	.537
.030	.390	.488	.537	.585
.035	.440	.537	.585	.635
.040	.488	.585	.635	.683

The low initial investment in storage and utilization equipment, the low cost per therm of butane, the small amount of labor involved in operation, the wide range and flexibility of mixing control and the varied possibilities of securing additional volumetric increases, combine to make butane the ideal medium for meeting peak load conditions and as a standby gas reserve.

Summary

The future of the liquefied petroleum gas industry will be closely interconnected with that of the natural gas industry. Having a common source and origin, the use of one to supplement and extend the field of the other offers possibilities of common distribution control by which both industries will mutually benefit.

AT RIGHT:

View showing appliance display at the newly opened office of the Natural Gas Corporation of Washington at Camas, Wash.

Pacific Coast Service Area Gains

CONSTRUCTION activities of Natural Gas Corporations of Washington, Oregon and California brought butane service during March to several new communities in the three states, as well as putting ahead the program for supplying a number of other cities and towns.

Natural Gas Corp. of Washington put its first butane plant into operation at Camas on March 9, with J. E. Plaisted assigned as local representative. It is estimated that there will be a total of 525 consumers in this community by the end of the first year. Construction of the plant at Port Townsend was begun on March 2 under direction of Thebo, Starr and Anderton, Inc. Plants at Shelton, Port Angeles and Anacortes are nearing completion.

Open house was held on March 7 at Anacortes at the new store of the company in that town, and arrangements are under way for a similar affair at Port Angeles.

It is possible that the Natural Gas Corp. of Wash. may serve Washougal from its Camas plant.

Natural Gas Corp. of Oregon put into operation the plant at Bend on Thursday, March 5, with Ward D. Hopkins assigned as local representative. It is estimated that consumers will number more than 1,000 before the end of the year. Finishing touches were being put on the new plant at Cottage Grove, Ore., with service to start early in April. Work was started on the plant at The Dalles early in March.

An appliance display has been opened at Coquille, Ore., in preparation for service of Bugas in that town, and a franchise has been accepted at Tillamook by the company, indicating that a plant is to be constructed there.

Plans of the Natural Gas Corp. of Calif., called for beginning of service on March 23 at Dunsmuir and before the end of the month at Yreka, Calif., to be under the direction of S. R. Sharpton and O. W. White respectively. Construction is being completed under the direction of Thebo, Starr and Anderton, Inc.

Natural Gas Corp. of California has applied for a franchise to serve Bugas in Indio, Calif., situated in the Coachella Valley.

Southwestern Gas Co. Ready to Serve Barstow

Southwestern Gas Co., headquartered at Los Angeles, was incorporated recently, with Chas. F. Stern as president and Harold Laub as manager. Mr. Laub will maintain headquarters at Barstow, Calif., where a plant for the service of liquefied petroleum gas was expected to be placed in service on April 1. A second plant at Victorville is expected to begin serving the same type of fuel in that town on May 1. Appliance displays have been set up at the company's headquarters in both communities.

Lampasas May Have Butane

Lampasas, Texas, has granted a franchise to F. C. Stevenson of Fort Worth, Texas, for the service of either butane or natural gas, optional with the franchise holder.

"Bottled" Gases — Part II

A REVIEW of the "bottled" gas phase of liquefied petroleum gas service, containing information on manufacture, properties, utilization, and other aspects of the subject, was begun in "Western Gas" for February, quoting extracts from the recently published Letter Circular No. 292, issued by the Bureau of Standards. Concluding sections of the discussion appear below.

Effect of Impurities in Propane:

IF THE gas is evaporated in the supply tank and drawn from the top, it is essential that the liquid be propane of fairly high purity. Otherwise, a decided change in composition will result during the discharge of the fuel. The presence of a little ethane may cause a great deal of trouble from flashing back or blowing from the ports when a fresh cylinder is first connected. The presence of butane, on the other hand, will result in improperly aerated flames and incomplete combustion, particularly when the fuel is nearly exhausted. Table No. 3 shows the variation in the composition of the gas drawn at constant temperature from a cylinder filled originally with propane containing 10 per cent of ethane. Table No. 4 gives similar data for variation in composition of gas drawn from a supply of propane contaminated with a similar amount of butane.

It is not to be supposed, because these examples are given, that commercial propane is likely to contain as much as 10 per cent of another hydrocarbon. Much of it is at least 99 per cent pure and is practically indistinguishable in use from the absolutely pure substance.

Table No. 5 is given to show the different extents to which impurities affect the constancy of composition of the gas in the case of a single-cylinder system. If half the fuel is used after each filling, with propane containing 10 per cent of butane, the variation in composition during use is only about 10 per cent of that which results if the double-cylinder system is employed. Obviously, the smaller the fraction of the supply used between replenishments, the more uniform is the supply.

Table No. 6 is given to show the effect on the operation of a burner of varying the composition of the mixture from propane to butane. For a burner to remain in perfect adjustment without changes by the operator, the "B.t.u. per hour" (Column 4) and the "per cent of air required for combustion" (Column 5) which is injected as primary air should remain unchanged. The extreme variation shown in the tables is too great for satisfactory service.

Similar data are given in Table No. 7 for the gases prepared by bubbling air through pentane at different temperatures. The importance of placing the pentane container where the temperature will be as uniform as possible is clearly shown. At a depth of 6 feet the average ground temperature varies about 20° F. between winter and summer, the maximum varying, of course, with latitude.

Table No. 3. Composition of liquid and vapor during the vaporization of a liquid containing at the start 90 per cent of propane and 10 per cent of ethane.

(Vaporization at 70° F)

Liquid remaining % of original	Ethane in vapor %	Ethane in remaining liquid %
100	32.4	10.0
90	26.7	7.2
80	20.0	5.3
70	15.2	3.9
50	6.4	1.6
30	1.2	0.29
20	0.35	0.08
10	0 04	0.004

Table No. 4. Composition of liquid and vapor during the vaporization of a liquid containing at the start 90 per cent of propane and 10 per cent of butane.

(Vaporization at 70° F)

Liquid remaining % of original	Propane in vapor %	Propane in remaining liquid %
100	97.4	90
75	96.6	88
50	95.3	83
36	94.0	79
25	91.2	73
15	87	62
10	80	46
5	65	20
2	17	5
1	3	0.8

Table No. 5. Composition of liquid and gas in a container repeatedly filled with a mixture of 90 per cent of propane and 10 per cent of butane if one-half of the material is used from the container after each filling.

No. of Fillings	Composition after Filling		Composition when Container is Half Empty	
	% Propane Liquid	% Propane Vapor	% Propane Liquid	% Propane Vapor
1	90.0	97.4	83.0	95.3
2	86.5	96.4	76.9	93.1
3	83.5	95.5	72.9	91.5
4	81.5	94.8	69.2	90.0
5	79.6	94.2	67.3	89.1
8	77.2	93.2	63 3	87.5
10	76.4	92.9	62.4	87.2
20	76.1	92.8	62.2	87.0

Table No. 6. Properties of mixtures of gaseous propane and butane. Under operation of burner it is assumed that a burner is adjusted with pure propane to give 10,000 B.t.u. per hour and 60 per cent of the air required for combustion is primary air.

% propane in mixture	Heating value B.t.u./cu. ft.	Specific gravity (Air=1)	Operation of a burner	
			B.t.u./hr.	Primary air % required for combustion
100	2575	1.562	10,000	60
90	2652	1.613	10,130	59
75	2769	1.689	10,340	58
50	2962	1.810	10,680	56
25	3156	1.941	10,990	55
0	3350	2.067	11,300	53

Table No. 7. Composition and other properties of air saturated at different temperatures with pentane vapor. Under "operation of burner" it is assumed that a burner is adjusted for a mixture saturated at 70° F to give 10,000 B.t.u. per hour and to take 60 per cent of the air required for combustion as primary air (including the air in the gas supply).

Temp.	% pentane in mixture	Specific gravity (Air=1)	Heating value B.t.u./cu. ft.	Operation of a burner	
				B.t.u./hr.	Primary air % required for combustion
32°F	24	1 38	985	4600	134
50°	38	1.60	1560	6700	90
70°	62	1.97	2540	10,000	60
97°	100	2.57	4100	14,100	41

Missouri Gas & Utility Co. Is Newly Organized

Missouri Gas & Utility Co., newly organized, was recently granted a franchise for the service of butane gas at De Soto, Mo., and plans construction of a plant and distribution system immediately. The same company has applied for a franchise at Rolla, Mo. Thos. Bowdern and C. C. Ogle are named as representing the company.

Rockwell City, Iowa, to Have Either Butane or Natural

Phillips Petroleum Utilities Co. recently secured a franchise for the service of either natural or butane gas in Rockwell City, Iowa. If supply is not brought from the main transmission line of the Missouri Valley Pipe Line Co., a butane plant and distribution system will be installed.

Increase Propane Plant Capacity

The Skelgas plant at Lyman, Okla., of the Skelly Oil Co., headquartered at Kansas City, Mo., is planning to increase its production of propane gas by 2,000 gallons daily as a result of improvements to the plant.

Skelly Oil Co. Plans Two Butane Plants

Skelly Oil Co., Kansas City, Mo., is planning construction of a butane plant at Tipton, Iowa, and one at Montevideo, Minn.

Ogle Applies to Serve Flagstaff

C. Cicero Ogle of St. Louis, Mo., has applied for a franchise for the service of butane gas in Flagstaff, Ariz.

THE WEST ESTABLISHES A MARVELOUS ADVANCE IN GAS STOVE DESIGN

P R E S E N T I N G

ARISTOCRAT OF THE WEST

The New SPARK

"Senorita"

Insulated-Oven Lid-Top

The SPARK "SENORITA" strikes a new note in the scale of aristocratic beauty—provides new avenues for profitable merchandising. » » » » » » » » »

AVAILABLE IN VARIED TRIMS, WITH AND WITHOUT TRASH BURNER (SEE NEXT PAGE)

THE NEW SPARK "SENORITA"

IS THE MOST IMPROVED INSULATED-OVEN STOVE OF THE AGE

★ ★ ★

DURING the recent period of radical changes in gas stove design, Hammer-Bray Co. engineers and designers have been constantly on the alert — Our investigations have carefully analyzed consumer acceptance of various modern departures in construction, design, color and finish.

As a result, the Spark "Senorita" strikes a new note in the scale of beauty with its artistic lines; finished in porcelain enamel, a combination of rich mellow old-ivory and marbled effects; NOT so radically modern as to be out of place in the more modest kitchen, but still so aristocratically different as to fully harmonize with the most modern kitchen setting. » » » » » » » » » » » » »

This lid-top stove embodies all of the former well-known Spark patented features with many added innovations. » » » » » » » » » » » » » » »

Model illustrated on preceding page has famous Spark patented extension gas burner—adds fifty per cent gas cooking surface. Also has gas trash and kindler burner.

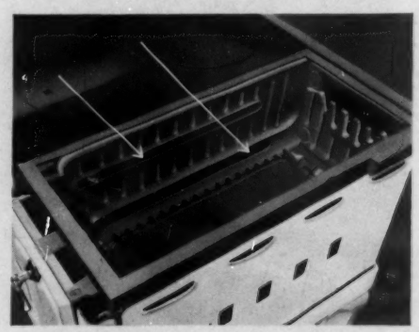
Famous ventilated "even-heat" oven with moisture-proof, reinforced insulation. Extra wide flues that insure "even-heat" distribution. » » » » » » » » »

New type "aereated" concealed manifold — cool valves. One-piece porcelain lid-top. Four extra large lids and removable grates. » » » » » » » » »

Heat-protected oven door springs. » » » » »

Write today for further details.

TWO ADDITIONAL BURNERS

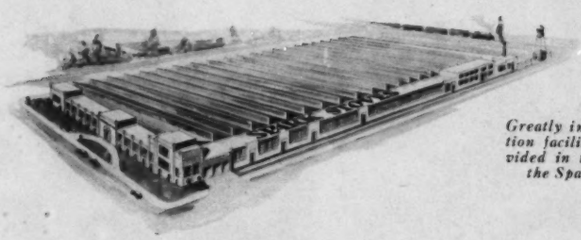


Arrows show full-length patented extension burner and kindler burner. » » » » » »

Hammer-Bray Co.

MANUFACTURERS

OAKLAND - - CALIFORNIA



Greatly increased production facilities will be provided in the new home of the Spark "Senorita."

Commercial Markets *on the* Butane System

By T. E. BARTLETT

Manager of Sales,
Natural Gas Properties, Inc.

MUCH has been said during the past few months concerning use of liquefied petroleum gases for domestic purposes, due to the rapid development of air-butane gas plants throughout the various sections of the country. Undoubtedly the domestic load will always be the primary revenue for such air-butane plants, but at the same time it is well to give thought to development of the commercial market, which will have its bearing on the success of this new service.

That there is a definite field for the application of this air-butane gas for commercial purposes has been demonstrated throughout the newly opened territory of Natural Gas Corp. of California, particularly in the Vacaville group of the company properties.

One particular commercial heating installation is of special interest, due to the fact that the use of an air-butane gas system has solved a problem long confronting the owner, who has found several systems burning other fuels quite unsatisfactory.

This job is located in the Vista Theatre at Rio Vista, Calif., which has an auditorium seating about 500 people. The general construction of the building was an aid in making this a most successful installation, as it allowed ample space back of and under the stage for the construction of the heating and venting system. Another aid was the fact that the management was primarily interested in obtaining an efficient and satisfactory system with correctly designed equipment, rather than making price the deciding factor.

T. E. Bartlett

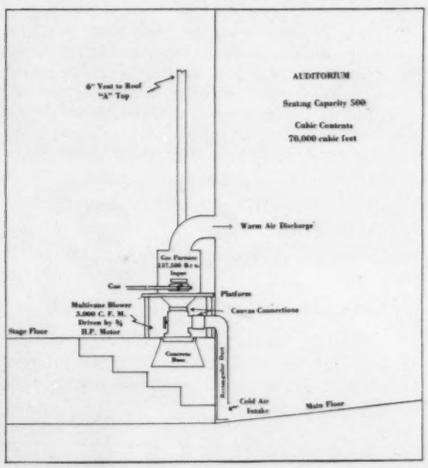
A unit heating system was used, one unit being placed on the right hand side and another on the left hand side of the stage, which, as can be seen from the accompanying sketch, eliminates any transmission or frictional losses, due to the direct method in which the cold air is drawn from the floor, passed through the blower and furnace, heated and passed directly back into the building, the static pressure being a trifle less than one quarter of an inch.

An oversized multi-vane blower was used, running at a speed of approximately 275 R.P.M. and mounted with the motor on a concrete block, sufficient space being allowed around the concrete block so that no vibration might be transmitted to the surrounding woodwork. Canvas connections eliminate all metalic vibration of the intake and exhaust of the vane.

This installation makes it possible to raise the temperature of the theatre to the desired degree quickly, and eliminates all waste of heat, as the plant may be immediately cut off when desired.

Due to the success of this system, two other theatres are planning similar installations on the company's lines.

This theatre heating job is only one of the many commercial uses to which air-butane is being put in our territory. In the Chinese sections around Isleton and Rio Vista, "chop suey" houses are converting to air-butane



from other fuels. One of the problems of a chop suey house has been the matter of keeping the prepared food hot during the day, without having the temperature vary to a great degree. This has been solved by the installation of a 12-inch conversion ring burner, with an iron frame for the holding of the chop suey pot. This is a very inexpensive installation, and at the same time provides a steady, even heat at the required temperature.

Another novel use of gas in the Chinese section is that of lighting—there being about 15 buildings so equipped with Welsbach gauze burners, in place of the old Bunsen burner formerly used for lighting.

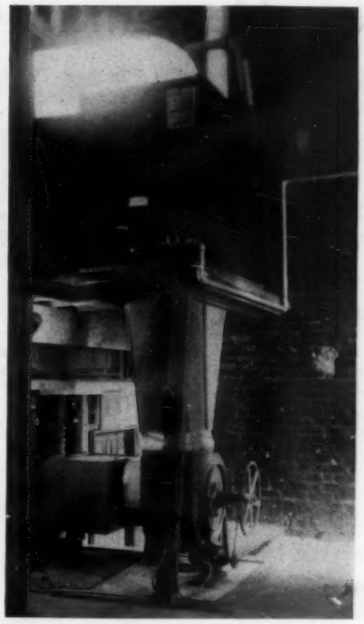
Auto laundries present another field for gas service, as gas provides an abundance of hot water easily maintained at the desired temperature.

Soldering irons represent another use, gas heating the irons in less time and at less expense than electricity, which has been principally used for this purpose in the smaller communities.

There is, of course, the usual field for restaurant and candy cooking equipment, which is being rapidly developed throughout our territory.

A gas circulating heater is also being installed in one of the smaller laundries for use in the drying room, which will be utilized during rainy weather.

Gas heater installations in rooming houses and small hotels are also proving quite satisfactory. We are installing radiant-type heaters in each room, some operated on prepay



Heating installation operating on butane, at Vista Theatre, Rio Vista, Calif.

meters, and others on a central meter for the house. It is found these may be operated at a cost of approximately 2½c per hour. Gas heat has aided in keeping at least one hotel in our territory open during the winter months, which has heretofore been impossible.

Cannery cottages and similar groups of houses are found in the outlying sections where air-butane gas service is now available. Gas plates are the principal factor here, although radiant-type heaters also play their part. It is estimated these plates may be operated an average of four hours per day at a cost to the canning company of about 6c per cottage, which is cheaper than oil.

In some cases the companies prefer to build their own distribution system and operate prepay meters, gas being served by one master meter. In other instances, the gas company makes the complete installation and takes care of the collection of bills, with a certain guarantee made by the canning company to cover transient turn-ons.

Northland Utilities in Minnesota Franchising Activity

Northland Utilities Co., Hibbing, Minn., has been granted a franchise at Cloquet, Minn., and will install a butane-air gas plant as soon as weather allows. The company owns and operates plants at Chisholm and Eveleth, Minn. The same company applied early in March to serve Grand Rapids, Minn., with butane gas. Application was also made at Two Harbors, Minn.

Texota Service Corp. Gets Little Falls Permit

Texota Service Corp., affiliated with Western Service Corp., Oklahoma City, Okla., has been granted a franchise in Little Falls, Minn.

New Department Gets Warm Welcome

THE *Western Gas* "Butane - Propane News" department, inaugurated in the March issue as a regular feature, has met with a highly favorable reception—indicating the tremendous interest which is centering upon liquefied petroleum gas service. Typical of the response to "Butane-Propane News" are the following comments, taken from letters received by *Western Gas* during the past month:

Send 25 Copies!

". . . We would be very much interested in receiving about 25 additional copies of this reprint.

"Wonder if you can take care of us? . . ."

THE CLEVELAND HEATER CO.
O. A. Reiter,
Sales promotion manager.

May We Have 12 Copies?

"Thank you for your letter of March 5th enclosing a reprint from March issue on 'Butane-Propane News.'

"May we have 12 copies of this reprint, the cost of which we will gladly pay."

THE NEW METHOD STOVE COMPANY
R. C. Stanton,
Vice-president and general manager

Send Several

". . . and am interested in literature bearing on the subject, and I understand that you recently published a reprint from your March number including various data on the subject.

"I would appreciate it very much indeed if you will send me several copies of the reprint . . . "

Benjamin F. Kauffman

Will Prove Valuable

"Thanks for your nice letter of March 3, announcing your Butane and Propane News department. By all means put our Cutler-Hammer advertising in this section. I think this will prove valuable to your readers and therefore, to our client."

GEORGE J. KIRKGLASSER & CO.
(Advertising Agency)
H. Falvey

What the Industry Has Needed

". . . Our congratulations on your foresight in establishing a 'Butane-Propane News' section in your magazine. We believe that the industry has needed for some time some such effort. . ."

THE BASTAIN BLESSING COMPANY
E. L. Mills,
Sales manager

Twenty-Five Copies Please!

"We received your reprint entitled 'Introducing—Butane-Propane News.' Dr. Garner's article in this reprint is very interesting together with some general news items concerning the liquefied petroleum gas industry. We are writing to ask if you will be kind enough to send us 25 of these reprints as we can use them to great advantage.

"Kindly enter our subscription to *Western Gas* for one year and upon receipt of invoice, we will remit".

SUBURBAN GAS COMPANY
Mark Anton

Widespread Interest

". . . Your proposal to establish a regular department to be known as 'Butane-Propane News' in line with progress. There is widespread and thorough interest in the utility of these hydrocarbons . . ."

HOPE CONSTRUCTION & REFINING CO.
J. B. Garner

Will Be Read Widely

" . . . We are glad to hear that you are planning to establish a regular department in *Western Gas* for the 'Butane-Propane News'. With the rapidly increasing attention that is being shown toward these products we feel sure that this new department will be read widely and with a great deal of interest. . .. "

UNION OIL COMPANY OF CALIFORNIA
J. B. Arthur
Manager Fuel Oil and Asphalt Sales

Of Considerable Interest

". . . The 'Butane-Propane News' section of your magazine is of considerable interest to me and I am sure that many others also would be interested in it. I hope that it will be possible for you to continue this section and I would like very much to receive copies of it as published."

UNITED STATES DEPARTMENT OF COMMERCE
Bureau of Mines, Washington
E. B. Swanson, Chief Economist,
Division of Petroleum Economics

Find It Interesting

"I greatly appreciate your letter of March 12th, enclosing reprint of the new section 'Butane-Propane News', that is to be included as a feature in *Western Gas*. I find this reprint so interesting that I would like to obtain about six copies, if possible, to give to other members of our Committee.

"We shall greatly appreciate your entering our subscription to *Western Gas* and sending us an invoice which we will honor immediately.

COMPRESSED GAS MANUFACTURERS ASSN.
F. R. Fetherston
Secretary

10 More Copies!

"We are very much interested in the reprint from your March 1931 issue of *Western Gas* entitled 'Butane-Propane News' as attached to your letter of March 5.

"If additional copies of this reprint are available, we would very much appreciate about 10 more copies."

BAILEY METER COMPANY
H. M. Hammond,
Mgr. Sales and Engineering

Bureau of Mines Data Show Increased 1930 Output

MARKETED production of liquefied gases, principally propane and butane, during 1930 reached a total of 18,017,347 gallons, an increase of 81.4 per cent over the 9,930,964 gallons marketed during 1929 and nearly 300 per cent greater than the 4,522,899 gallons marketed during 1928, according to the United States Bureau of Mines, Department of Commerce, following the completion of a survey of 1930 operations by E. B. Swanson, chief petroleum economist. The first survey of production, completed in June, 1930, reported the quantities marketed annually from 1922 to 1929, inclusive.

Marketed Production of Liquefied Petroleum Gases, 1922-1930

Year	*Gallons*
1922	222,641
1923	276,863
1924	376,488
1925	403,674
1926	465,085
1927	1,091,005
1928	4,522,899
1929	9,930,964*
1930	18,017,347

*Revised.

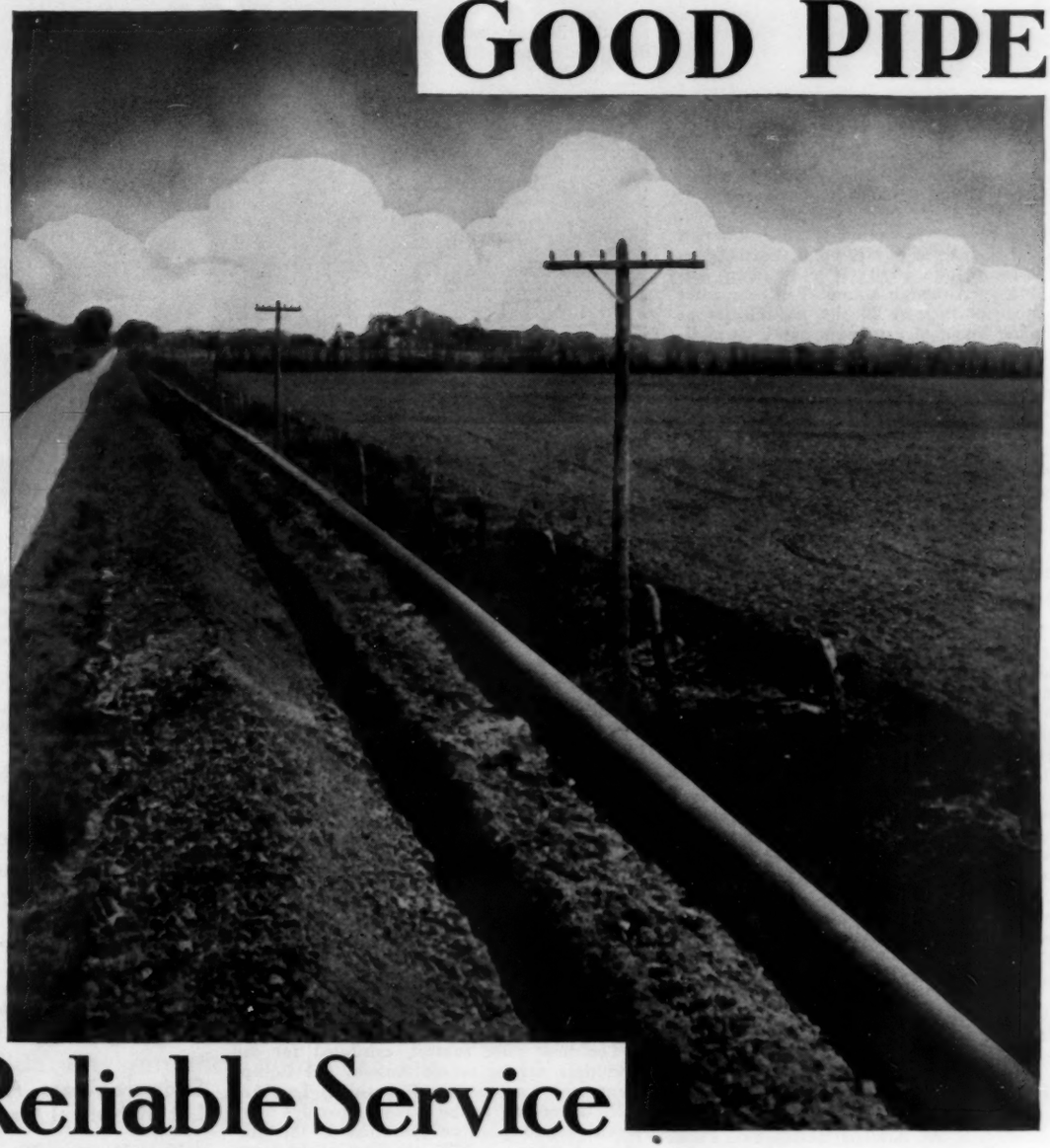
An approximate segregation of the gases marketed indicates that the 1930 distribution of propane was in the neighborhood of 11,500,000 gallons, virtually twice the 1929 distribution, while the distribution of butane, iso-butane, pentane and butane-pentane mixtures used for comparable purposes, reached a total of about 6,500,000 gallons, approximately 50 per cent more than during 1929.

It is estimated that 117,000 customers were served with propane as "bottled gas" during 1930 as compared with 55,000 in 1929 and 20,000 in 1928. The indicated average consumption per installation was 98.6 gallons.

The outstanding 1930 development in the use of butane has been the establishment of numerous central stations in communities too small to support a gas service of the ordinary manufactured or natural type. Several communities in California, Oregon and Washington during 1930 received their first gas service in this manner, while the number of such plants in the remainder of the country also continued to increase.

Data gathered by the Bureau of Mines also indicate increased use of butane and other liquefied petroleum gases to replace gas oil in carburetting gases of relatively low thermal value; as a base material for manufactured gases; for the re-carburetion of gases to offset the loss of thermal value in high pressure transmission systems; to meet peak load conditions and as a protection against interruptions of service. These gases

The First Requisite . . . . . GOOD PIPE



For Reliable Service

Continuous and unvarying service to patrons is the essence of what a gas company sells. An uncertain or irregular service would be a service of limited value.

Because they appreciate this fully, and because they realize that durable, sound pipe is the first requisite for reliable service, many leading gas companies in all parts of the United States have made NATIONAL their standard.

Strength adequate for high pressures, unusual ductility, and excellent working quality in all respects, are among the merits that commend NATIONAL Pipe to informed users and are factors that have made it—

America's Standard Wrought Pipe

NATIONAL TUBE COMPANY, PITTSBURGH, PA.
Subsidiary of United States Steel Corporation

NATIONAL PIPE

also have been applied to a number of industrial purposes during the past year.

Although pentane is a liquid at ordinary temperatures, it was included in the survey to the extent that it was marketed for purposes similar to the other gases. Individual gas systems, in which air is passed through the pentane container, supply a mixture of air and pentane which is used to a considerable extent in individual dwellings. Approximate data relative to the distribution of pentane for this purpose indicate a substantial increase during 1930 in the number of installations of such gas systems.

The producers of liquefied petroleum gases operating during 1930 and reporting distribution to the Bureau of Mines were identical with those reporting for the preceding year. These producers were listed in connection with the Bureau of Mines press statement issued during June, 1930 (*Western Gas*, August, 1930). Although a number of companies indicated an interest in the possibilities of producing liquefied petroleum gases, no additional producers were reported. It is probable, however, that the number of local distributors of these gases increased. The increased number of inquiries received by the Bureau of Mines indicates a growing interest in the production and distribution of these gases and the development of additional services for which liquefied petroleum gases may be utilized.

West Coast Gas & Fuel Wants to Serve in 12 Towns

The California Railroad Commission will hold joint hearings in May on applications pending for certificates of public convenience and necessity permitting the West Coast Gas & Fuel Co. to build and operate gas plants in 12 California cities.

The present program contemplates the installation of air-butane plants and service of 550 B.t.u. gas. The towns in which franchises have already been granted include Sonora, Jamestown, Angels, San Andreas, Jackson, Sutter Creek, Placerville, Auburn, Susanville, Alturas, Lakeport and Kings City.

The company is headquartered at San Francisco. The officers are president, Edward Schary, vice-president and engineer, F. Emerson Hoar, and the directors are William Peck, Louis T. Grant and A. Andrane.

Arizona Edison Asks to Serve Butane in Five Towns

Hearings were held before the Arizona State Corporation Commission in March upon application of the Arizona Edison Co., Phoenix, to serve butane gas in Gila Bend, Florence, Casa Grande, Superior, and Winkleman. Southwestern Utilities Co. is also applying in Casa Grande.

Alexandria, Minn., in Line For Butane Service

Alexandria, Minn., is considering the franchise application of H. H. Henley, representing the Municipalities Gas Corp. of Minneapolis, Minn., for service of butane gas.

Santa Maria Gas Co. Asks to Serve Buellton, Calif.

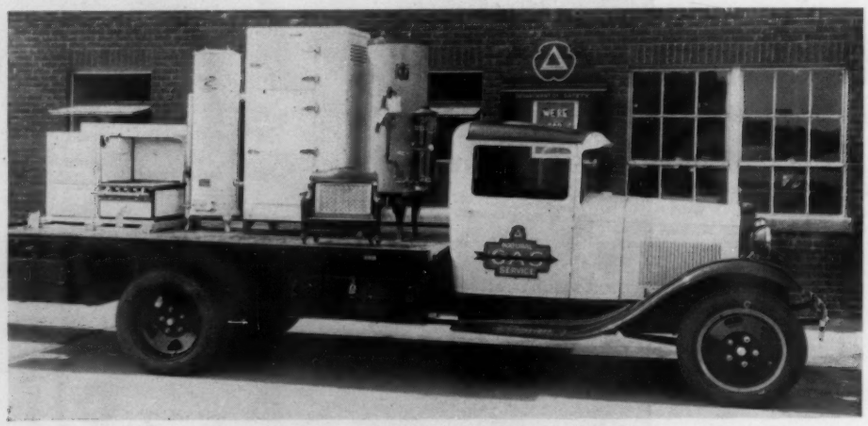
Santa Maria Gas Co., Santa Maria, Calif., has applied to the State Railroad Commission for a certificate of convenience and necessity to exercise franchise rights for the service of butane gas in Buellton, Calif.

Permit for Gas Service at Caruthersville, Mo.

W. A. Howard and S. J. Campbell of Kansas City, Mo., on March 6 were granted a franchise for the service of gas in Caruthersville, Mo. The interests which they represent plan to construct a butane plant and distribution system or to construct a pipe line from Poplar Bluff to the town. Poplar Bluff is served from the main line of the Mississippi River Fuel Corp., from Louisiana fields to St. Louis.

Butane for Watseka, Ill.

Great Northern Utilities, Inc., headquartered at Chicago, Ill., announces plans for construction of a new butane plant at Watseka, Ill.



So. Cities Distributing Co.'s New Appliance Truck

THE truck shown in the illustration above was recently added to the fleet of the Southern Cities Distributing Co., Shreveport, La. The body of the truck is 7 feet wide and 12 feet long, constructed of 1-inch boards reinforced with 1½-inch strip of angle iron around the edge to prevent the appliances from sliding off. There are two all steel fittings boxes on either side of the truck which contain several small compartments for carrying the various sized fittings. There is also a steel locker underneath the rear of the truck to carry a tarpaulin for use in stormy weather, tools, vises and other miscellaneous equipment. A heavy 2-inch skid board is carried on rollers just underneath the body.

The specially built body is built on a 1½-ton, Model A, Ford chassis and the entire cost of the completely equipped truck is less than a thousand dollars.

New Control Development Announced by N. G. E. Inc.

A new development in the design of pilot control for pressure regulators, liquid level controllers or hand remote controls has been announced by Natural Gas Equipment Inc.

The new pilot control, exhibited for the first time at the recent Annual Oil Equipment and Engineering Exposition, Los Angeles, according to the makers provides more sensitive and positive operation of the diaphragm valve to which it is applied than was previously possible. It makes the use of a reducing regulator to maintain a constant auxiliary pressure unnecessary, is free from interruption of service, and eliminates continuous bleed. It represents a further development of the original pilot control principle introduced by Natural Gas Equipment engineers and the Wilgus Manufacturing Co. in 1925.

Data sheet 101a, describing this pilot control and illustrating its various applications, will be furnished upon request to Natural Gas Equipment Inc., Petroleum Securities Building, Los Angeles.

Public Service Co. of Colorado Completes 117,000,000 c. f. Job

Public Service Co., of Colo., recently completed a natural gas installation at the Capitol Hill pumping station of the Denver water system. The water system is operated by the City and County of Denver board of water commissioners. The installation included one 2,300 H. P. Babcock and Wilcox water tube boiler and one 2,100 H. P. horizontal return tubular boiler, equipped with Webster burners. The new load will approximate 117,000,000 cubic feet per year.

Skidmore, Texas, Added to List of Natural Gas Cities

The Houston Pipe Line Co., Houston, Texas, has recently completed the construction of 10 miles of 2-inch line, tieing-in to the main line of the company at Beeville, Texas, and extending to Skidmore. The town of Skidmore is served by the Houston Natural Gas Co.

Frank Kirk President of So. Texas Chamber of Commerce

Frank W. Kirk, general manager of the Houston Pipe Line, Houston, Texas, was recently elected to the presidency of the South Texas Chamber of Commerce. Chambers of Commerce in 59 counties in southern Texas are affiliated with the South Texas chamber.

Considering Municipal System

Panhandle, Texas, is considering construction of a municipal gas distribution system.

MINNEAPOLIS
HONEYWELL

For a Greater
GAS HEATING INDUSTRY!

TIME-O-STAT

In many respects, the latest step in the growth of Minneapolis-Honeywell is the most important amplification of engineering, manufacturing, distribution and service resources in the history of automatic heat controls

The recent acquisition of Time-O-Stat by Minneapolis-Honeywell simplifies your entire job of selecting the right automatic controls for every form of house-heating.

1. A Complete Line. Now you can get, from a single organization, exactly the controls you need and *all* the controls you need. No matter what your engineering requirements are, and no matter what your price and selling plans may call for, you can get from the single enlarged line made by Minneapolis-Honeywell, precisely the right controls in the price range to fit your needs.

2. A Single Service Organization. This consolidation simplifies house-heating control service in the gas company service department. It gives you the backing of a single organization of Minneapolis-Honeywell service engineers located in every population center of the country.

3. Consolidated Engineering and Research Laboratories. It means a strengthening of the engineering experience and ability which have developed the basic forms of gas heating control and are now exploring into the possibilities of entirely new control mechanisms and hookups. It means even more rapid development of controls for industrial space heating and industrial processes.

It means a concentration of laboratories and manufacturing facilities into one organization which stands shoulder to shoulder with you for an even greater gas heating industry.

We are on the threshold of revolutionary progress in domestic, commercial and industrial heating. Now, even more than in the past, you can carry forward the most advanced experimental work with full confidence that all your automatic control requirements can and will be met by this organization, the outstanding leader in the development and manufacture of automatic heat controls.

MINNEAPOLIS-HONEYWELL
REGULATOR COMPANY

California Branch: 557 Market Street, San Francisco, California
Distributors: Portland, Seattle, Salt Lake City, Denver
Time-O-Stat Controls Division, Elkhart, Ind.

IT'S
GOOD BUSINESS

to stop where
Business is Good!

2,500 rooms. A radio, tub, shower, circulating ice water, Servidor in every one of them. Extra value!

Every room an *outside* room —and 85% of them priced at $3.50 to $5.00. Extra value!

116 new sample rooms. 4 popular price restaurants, including a "speed counter" Coffee Shop—with food that is the talk of the town. Extra value!

A location in the heart of midtown Manhattan "next door to everything". Private tunnel to the Pennsylvania Station. B. & O. Motor Coach connections, too. Extra value!

The overwhelming success of the Hotel New Yorker is not built upon low rates alone; it is built upon BIGGER AND BETTER VALUE. Come and get it.

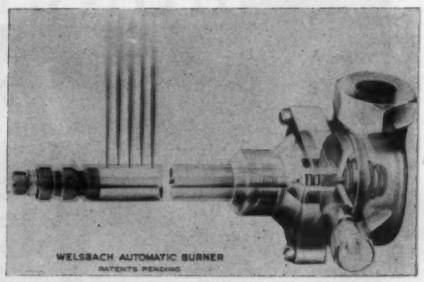
HOTEL
NEW YORKER

NEW YORK'S MOST POPULAR HOTEL
34th Street, at 8th Avenue, New York
RALPH HITZ, MANAGING DIRECTOR
Chicago Office: 77 West Washington Street

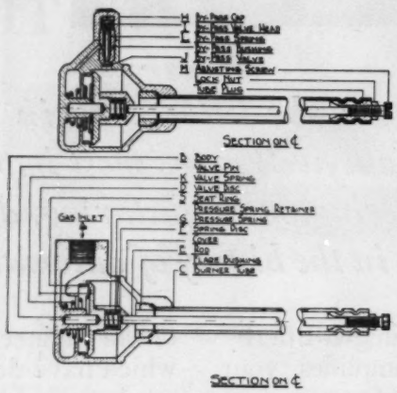
Welsbach Introduces Automatic Burner

WELSBACH Co., Gloucester, N. J., supplies the following description of operation of the recently introduced Welsbach automatic burner, on which patents are pending.

In the accompanying drawing the burner is shown in the off position and, therefore, with the valve closed. Gas under pressure at "A" enters the chamber in the body "B" and is prevented from flowing to the burner tube "C" by the valve disc "D" pressed against the seat ring "S" by the Invar rod "E" transmitting its force to the valve through the spring disc "F" and pressure spring "G." In order to light the burner it is necessary to heat the tube so that the valve will open, and this is accomplished by manipulation of the small by-pass shown in the upper view of the drawing. The operation of this by-pass is as follows:



Phantom view of the new burner



The by-pass cap "H" is removed and the by-pass valve head "I" pressed and at the same time a lighted match applied over the ports on the burner tube "C." By pressing the by-pass valve head "I" the by-pass valve "J" is opened and gas flows through the passage shown around the main valve "D" and into the burner tube "C." Gas burning on the burner tube heats it and it expands, the right hand end moving towards the right allowing the valve spring "K" to force the main valve "D" off its seat. The gas then flows directly to the burner through the main passage. When the main valve opens the flames immediately lengthen and then the by-pass valve head "I" can be released permitting by-pass spring "L" to close by-pass valve "J." By-pass cap "H" is thereupon replaced. With the burner in operation should the flames be extinguished the burner tube will cool and contract, forcing the valve disc on its seat and shutting off the main gas passage. The by-pass having been automatically closed by its spring when the burner is lighted allows no gas to pass to the burner through this passage. A complete cut-off of gas supply to the burner is thus secured.

The compensating action of the burner operates as follows: Should the gas pressure become greater than normal the flames have a tendency to leave the burner tube; under this condition the tube becomes cooler which in turn slightly closes the main valve "D." Conversely, should the pressure decrease, the flames would tend to hug the tube, heating it slightly above its normal temperature, and this would cause valve "D" to open further and allow more gas to pass.

Anderson to Head McEverlast; Other Officers Named

George W. Anderson, president of the Imperial Hardware Co., on March 17, was elected president and general manager of McEverlast, Inc., of Los Angeles, engaged in the manufacture of protective pipe coverings and hot process for curing concrete.

Mr. Anderson served in the capacity of secretary and treasurer a few years ago and it is expected he will assume active charge of the company at once. Edward R. Young and Fred F. McRae were elected vice-presidents and J. V. Schertz, secretary and treasurer.

Coast Counties Gas and Electric Issues Yearly Report

Coast Counties Gas and Electric Co., Santa Cruz, Calif., has issued its yearly report to stockholders, compiled in 20-page booklet form, giving summary of operations for the year ending December 31, 1930.

The most important development during the year was the change-over from manufactured to natural gas, brought from the Kettleman Hills in the San Joaquin Valley. A total of 616,542,000 cubic feet of gas sold was reported for 1930 as compared with 453,921,000 cubic feet in 1929, an increase of 162,621,000 cubic feet. New customers totaling 2,075 were added to gas distribution mains.

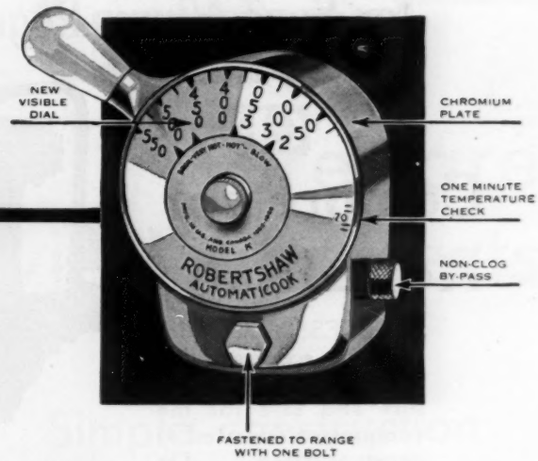
Compressor Plant at Abilene, Kan., Completed

Kansas Pipe Line & Gas Co., Salina, Kan., recently completed a new compressor station at Abilene, Kan. The installation includes six Cooper Bessemer 1,000 h.p. twin tandem gas engine driven compressors each having a capacity of 12,000,000 cubic feet of gas daily. The station is located two miles south of Abilene, on the company's line from Barber County fields in Kansas, to Grand Island, Neb.

Franchise at Parkville, Mo.

Gas Service Co., Kansas City, Mo., has secured the natural gas franchise at Parkville, Mo. Supply will probably come from the Leavenworth line.

ROBERTSHAW AutomatiCook



Proven *by* PERFORMANCE!

WHEREVER GAS RANGES are made, sold or used, the name ROBERTSHAW stands for proven performance in gas oven thermostats.

The Robertshaw AutomatiCook has won this preferred position because it is designed right, made right, and works right.

More than 150 gas ranges are made with the Robertshaw—and not one manufacturer who uses the AutomatiCook has ever changed his decision!

The Robertshaw is in daily use on thousands of ranges all over this country, safe-guarding millions of meals and rendering a faithful, unfailing service of unparalleled precision.

Regular equipment on **155** *well known* **GAS RANGES**

The American housewife knows what the Robertshaw means to her in releasing new hours of leisure from kitchen work. Consistent national advertising has made her look for and *want* the range with Robertshaw control.

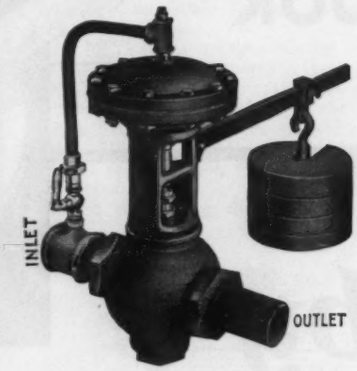
That advertising is one of the great supporting forces that is creating new range sales this year. It has made this trim little device, with its porcelain handle, full vision dial, and chromium finish, a signpost of quality on any range on which it appears.

If you would have real help in gas range merchandising, write at once for the vital reasons that make the Robertshaw the dominant thermostat.

ROBERTSHAW THERMOSTAT COMPANY
YOUNGWOOD, PENNA.

For *Speed Pump* Regulation use this CF

Compressor Regulator



NECESSARY relief of excess discharge pressure is made sure and safe for the compressor operated at constant speed. . . . On low pressure gas compressors, constant discharge is held without affecting pressure of supply main, regardless of differential between main and discharge pressures . . . . Equally successful for steam as a back-pressure regulator . . . Only means for close regulation of uniform pressure on electric driven pumps . . . Applicable for gas, air, steam and water.

THE valve has a definite positive movement for a definite change in discharge pressure and will remain indefinitely at some intermediate position between the wide open and closed position.

Excess discharge pressure flows through this regulator **without noticeable variation.**

Write for data pamphlet.

The Chaplin-Fulton Mfg. Company

Organized 1884—Oldest Builders of Gas Regulators in the Country. Built in all Sizes, From 1 Inch to 24 Inches; For All Service. 1 oz. up to 2000 lbs. Pressure to Square Inch.

28-40 Penn Ave. **Pittsburgh, Pa.**

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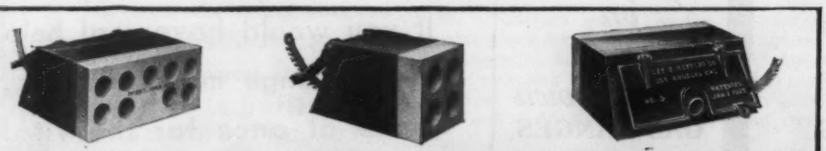


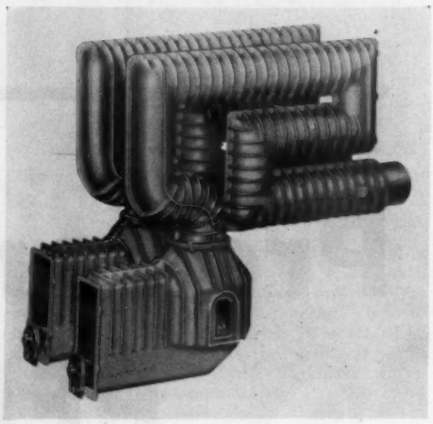
Mettler Entrained Combustion Gas Burners

FOR ALL Purposes
Kinds of gas
Pressures

406 S. Main St. LEE B. METTLER. CO. Los Angeles Cal.

Everlast Gas Cast Iron Furnace Placed on Market

The Everlast Gas Cast Iron Furnace Co., Los Angeles, Calif., has announced the manufacture of a new cast iron gas furnace which is sold under the trade name of "Everlast," and carries a 25-year guarantee. The company manufacturing the furnace is a new one, having for its officers the following: A. J. Hartfield, president; J. Anger, vice-president; J. A. Martin, treasurer; P. Johnston, secretary, and A. J. Braasch, second vice-president. Geo. Finney represents the company in the San Francisco district.



Burner of the new furnace

Second Line to Pine Bluff is Completed in March

W. M. Little, general superintendent of the Arkansas Division, Arkansas Natural Gas Corp., in March reported completion of the new 6-inch line to Pine Bluff from the Mississippi River Fuel Corp.'s 22-inch main line from Monroe field to St. Louis. The extension was constructed primarily for stand-by service and will enable Little Rock Gas & Fuel Co. to supply Pine Bluff either from Arkansas Natural's line or from that of the Mississippi River Fuel Corp. The line was constructed by the Arkansas Louisiana Pipe Line Co.

C. R. Shiers Replaces C. V. Fetter With Oklahoma Natural

C. R. Shiers, formerly superintendent of the Enid city plant of the Oklahoma Natural Gas Corp. headquartered at Tulsa, has been appointed temporary manager of the Enid District, replacing Charles V. Fetter, who is on an indefinite leave of absence because of ill health.

Texas Cities Gas Co. Plans Expenditures Totaling $100,000

An extension program of the Texas Cities Gas Co. at El Paso, Texas, will call for the expenditure of between $50,000 and $100,000 for 1931, including an extension to Highland Park district.

Kenmare Scheduled for Service

Montana-Dakota Power Co., Minneapolis, Minn., has been granted a franchise for the service of natural gas at Kenmare, N. D.

Service Calls

are rare with a Roberts

Simple construction
Carefree operation

Backed by
a merchandising plan
second to none in the
industry

Send for complete information!

No obligation

Heat YOUR HOME with Gas

ROBERTS-GORDON
APPLIANCE CORPORATION
CURTISS BLDG. BUFFALO, N. Y.

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CONTROLLED
GAS HEATING UNIT

Automatic Gas Fired Boilers

LATTNER

All Sizes from ½ to 30 H. P.

All Pressures.

P. M. LATTNER MANUFACTURING CO.

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516 12th Avenue
Cedar Rapids, Iowa

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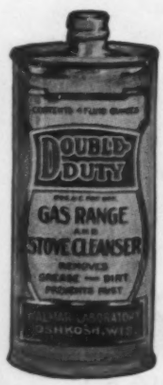


The Heart of Any Home Is the Kitchen Gas Stove
Keep It Bright and Clean By the Use of

DOUBLE DUTY
REG. U.S. PAT. OFF.

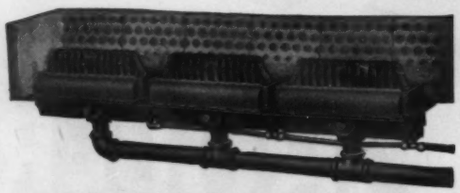
Removes Grease *Prevents Rust*

GAS RANGE & STOVE CLEANSER

WALMAR LABORATORY Oshkosh, Wisconsin

Western Distributor
C. B. BABCOCK CO., San Francisco, Los Angeles

R. M. C. Gas Burner



Durable Safe Economical

ROTARY MANUFACTURING CO.

5720 Long Beach Avenue Los Angeles, California

San Diego Consolidated Has New Chemical Laboratory

San Diego Consolidated Gas and Electric Co., San Diego, Calif., recently completed a new chemical laboratory, at 1005 Imperial Ave., consisting of an office, a large central room and two smaller rooms for special work. The main laboratory is furnished with chemical storage cabinets, steel lockers, a chemical bench, work tables, mechanical refrigerator and fume hoods. In one of the smaller rooms are especially built tables for gas analysis studies and fuel calorimetry. This room can be made dark for photomicrography and spectrometry.

Thirty-Five Iowa-Nebraska Towns Get Natural Service

Approximately 35 towns in Iowa and Nebraska were put on the list of natural gas users in 1930 through connections with the Missouri Valley Pipe Line Co.'s transmission line from Texas fields.

Iowa-Nebraska Light & Power Co., Lincoln, Neb., is credited with bringing the new fuel to 28 of these.

Towns scheduled for service from this carrier in 1931 include, Lyons, Walthill, Rosalie, Winnebago, Homer, Neb., Mason City and Fort Dodge, Iowa.

Seattle Gas Co. Conducts Five Cooking Schools in March

During the month of March the Seattle Gas Co., Seattle, Wash., conducted a series of cooking schools in conjunction with local newspapers in the following branch store districts: March 11 and 12, Security Market; 16 and 17, Rainier; 19 and 29, West Seattle; 23 and 24, Ballard; 26 and 27, University District. Miss Willa Campbell of the Tappan Stove Co., assisted the Home Service Department in the demonstration.

Brochure on Lava Gas Tips and Burners by Amer. Lava Corp.

American Lava Corp., Chattanooga, Tenn., recently brought from the press its Catalog No. 31, featuring lava gas tips and burners for industrial heating, and miscellaneous pilot and other tips for other lighting and heating purposes. The brochure contains 2-color charts, line diagrams and halftones, together with descriptions and engineering data. Copies may be obtained by addressing a request to the company.

Rates Lowered By San Joaquin Light & Power in Merced

The California Railroad Commission on March 16 authorized a reduction of gas rates in Merced by San Joaquin Light & Power Corp., of Fresno. The company is now serving manufactured gas in the town, that fuel to be superseded shortly by natural gas of 1150 B.t.u. content. The newly authorized rates will effect a reduction in consumers' bills of from 40 to 50 per cent.

Wyocolo Utility Corp. Wants to Serve in Craig, Colo.

The Wyocolo Utility Corp. has asked for permission to give a bond of $2,000 for a franchise for the service of natural gas in Craig, Colo., supply to come from wells near the city.

New Ideal Arcola Gas Boilers make hot water radiator heating practicable for small installations

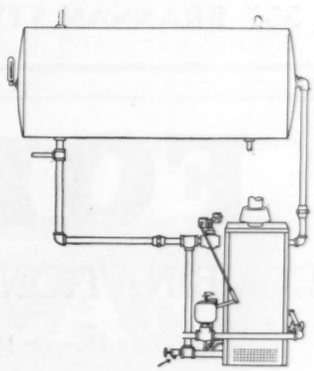
Here is a new field for sales and profits—the New Ideal Arcola Gas Boiler for small house heating installations and for hot water supply. Every feature of this boiler has been designed exclusively to meet the special requirements of small hot water installations. All the quality of product and all the exclusive control features of the other Ideal Gas Boilers have been included in this smaller compact model.

Either with or without jacket it is so attractive and so compact that it can be placed in any room and connected with radiators wherever needed.

This new heating plant is particularly adapted to small homes without basements, apartments, offices, stores, tea rooms, garages, barber shops and beauty parlors which have no central heating plant.

We will be glad to send a complete description of this new appliance that is opening up new opportunities for sales and profits.

For Direct Hot Water Systems the Ideal Arcola Gas Boiler makes an excellent installation. It has the advantage of compactness, high efficiency with large capacity and adequate automatic controls.



Manufactured by

AMERICAN RADIATOR COMPANY

DIVISION OF

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

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AMERICAN GAS PRODUCTS CORP.

CHRYSLER BLDG., NEW YORK

VITEX

—the perfect Gas Vent and Flue Pipe

Light Weight
Non-Corrosive
Insulating

. . . and
Easier and Cheaper to Install than Heavy Types of Pipe . . . . . .

For fully descriptive catalogue and prices write

PLANT RUBBER and ASBESTOS WORKS

537 BRANNAN STREET . . . . SAN FRANCISCO

PR-070

FORNEY

COMBINATION GAS and OIL BURNERS

For Power Plant and Industrial Uses

Write for Literature
and List of Installations

FORNEY COMBUSTION ENGINEERING CO.

513 CENTRAL BANK BUILDING, DALLAS, TEXAS

Plan For Improving Older Type Cooper-Bessemer Engines

A new folder has been issued by the Cooper-Bessemer Corp., Mt. Vernon, Ohio, outlining a plan to enable users of older models of Cooper-Bessemer gas engines to introduce added efficiency into their equipment.

A replacement steel cylinder head, power cylinder and gas economizer are included in the plan, which may be applied in whole or in part to any Type 8, Type 10 or Type E. C. engine now equipped with 16-inch cylinder. Copies of the folder may be obtained by addressing the company at the above address.

Merco-Nordstrom Valve Co. Moves Los Angeles Office

The Merco Nordstrom Valve Co. announces removal of its Los Angeles office, formerly at 556 South San Pedro St., to larger quarters at 1709 West Eighth St. The move, according to H. Boezinger, manager for southern California, was necessitated by a need for a more central location and additional space. Enlarged warehouse facilities will also be maintained.

North Vancouver Service Delayed Through Accident

Establishment of gas service at North Vancouver, B. C., has been indefinitely postponed owing to an accident to the bridge over Burrard Inlet which carried the transmission line.

This means that construction of a new bridge or erection of some other method of communication between the north and south shore of Burrard Inlet will have to be established before gas service can be resumed.

Ask Utah Legislature for Geology Board

A bill has been introduced in the Utah Legislature, asking for the formation of a State board of geology having for its duties the collection and distribution of reliable information regarding the mineral resources of the state; the study of geological formations; and the investigation of the kind, amount, and availability of mineral resources.

United Gas Plans Sales to Total $1,650,519 in 1931

The United Gas System plans for merchandising for 1931 have set a quota on the sale of gas fired apparatus as follows: 10,000 ranges, 5,000 water heaters, 10,400 space heaters; 17,792 new customers; $1,650,519, total merchandise sales, with an added revenue from appliances sold of $345,950.

Nebraska Natural asks Schuyler Permit

Schuyler, Neb., will vote on a natural gas franchise on April 7, the petitioning company being the Nebraska Natural Gas Co., headquartered at Lincoln.

"Natural" Available at Waterville

Waterville, Kan., now has gas available from the mains of the Kansas Pipe Line & Gas Co., with construction of the distribution system under way.

Now ready . . . the 1931 models of heavy-duty VULCAN *Gas Ranges*

For Hotels . . . Restaurants . . . Schools . . . Hospitals

This is what the new 4751 All-Hot-Top Vulcan looks like. It is but one of the new 1931 line of Vulcan Heavy Duty Ranges designed to meet modern and exacting requirements . . . Write for any information you require affecting your specific needs.

In the new 1931 line you find the best modern engineering design, plus all the features that have made Vulcan the leading line of heavy-duty gas cooking equipment for over a quarter of a century. A single unit of the new line (No. 4751 All-Hot-Top) is illustrated here.

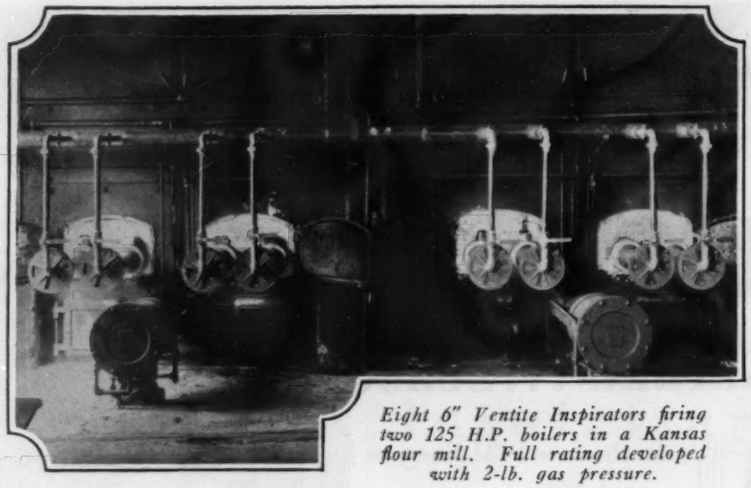
It has a hotter top of heavier construction. More working space. Concealed hinges, door springs, manifolds, flues. It's easy to keep clean and easy to service. The unbroken surface of its front makes a handsome appearance in the kitchen. All air shutters and gas cocks are protected from dust and grease.

If you want to cut your gas bills and keep your shins and kitchen cooler, you can have the new Vulcan with insulated oven. If you like oven heat control, you can have that, too. It's the best looking and best working range on the market. Full information for the asking.

Vulcan also makes bake-ovens, fryers, fast broilers, candy furnaces . . . in fact can outfit the finest big kitchens with every modern gas cooking appliance.

VULCAN GAS HOT TOP RANGES

STANDARD GAS EQUIPMENT CORP., 18 East 41st Street, New York City . . .
Pacific Coast Distributor: Northwest Gas & Electric Equipment Co., Portland; San Francisco; Los Angeles.



Eight 6" Ventite Inspirators firing two 125 H.P. boilers in a Kansas flour mill. Full rating developed with 2-lb. gas pressure.

THE IDEAL BURNER FOR THE "IDEAL BOILER FUEL"

Wherever natural gas is available at pressures of 6 ozs. or above, the Ventite Inspirating Burner can be used to fire boilers.

The Venturi principle of air injection provides the same ratio of air-gas mixture throughout the entire capacity range of the burner.

If the gas pressure is raised, the air entrainment increases in proportion; accordingly, the character of furnace atmosphere remains constant without any manipulation of drafts.

Automatic Control thus becomes a simple regulation of a single master gas valve.

Seven sizes. Capacities up to 10,000 cu. ft. per hr.

Prices from $9.75 to $98.00 complete

The standard pipe threads by which the nozzle is screwed on the Venturi tube allow for the insertion of street elbows or such standard fittings as may be necessary to adapt the burners to the individual boiler. Thus the tubes may be arranged parallel to the boiler front, if desired.

Shipment to points west of Mississippi River can be made immediately from Lincoln, Neb., warehouse

THE MAXON PREMIX BURNER COMPANY

MUNCIE, INDIANA, U.S.A.

GAS BURNERS

For

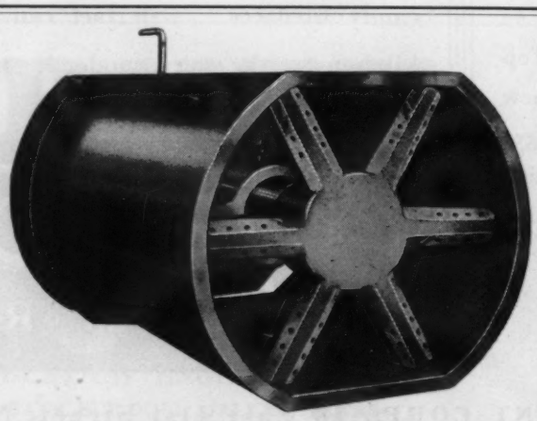
ALL INDUSTRIAL PURPOSES

JOHN ZINK CO.

Oklahoma Natural Gas Bldg.
Phone 4-9838
TULSA, OKLAHOMA

★

Flameless Burners
Flame Burners
Short Flame Burners



Four Companies Merge in Trojan Engineering Corp.

Trojan Engineering Corp., the outgrowth of a merger of the Trojan Engineering Corp. and the Public Works Engineering Corp., has acquired under the merger the Natural Gas Engineering Corp. of Tulsa, Okla., as well as the stock of the Phoenix Engineering Co. of Birmingham, Ala. The changes do not involve the actual operation of the companies. They will continue as in the past to render construction service to the gas and oil industries.

Offices are maintained by the Trojan Engineering Corp. in New York, Wilkes Barre, San Francisco, Tulsa and Birmingham. Joseph N. Greene is vice-president and general manager of the company. Thomas H. Wiggin is vice-president and chief engineer. R. W. Hendee, vice-president of the Oklahoma Natural Gas Corp., and a vice-president of the Natural Gas Engineering Corp., is also vice-president of the Trojan Engineering Corp. James L. Harrop, formerly chief engineer of the Missouri Public Service Commission, is vice-president in charge of appraisals for the company.

"U-G-S" Is Name of United House Organ

The name "U-G-S" has been given to the monthly house organ of the United Gas System, headquartered in Houston, Texas, following a contest conducted by the company late in 1930. The January number of the magazine was the first issue to bear the new name given to it by William L. Pedicord, of the survey department, Houston Gas and Fuel Co., Houston, Texas. The magazine has adopted the slogan "Unity Guarantees Service."

McWane Opens New Kansas City Sales Office

The McWane Cast Iron Pipe Co. and the affiliated Pacific States Cast Iron Pipe Co. announce the opening of the new Kansas City sales office for the sale of McWane cast iron pipe and fittings in the territory covered by the states of Nebraska, Kansas, northern Oklahoma, and Missouri (except St. Louis).

The new office, located at 1006 Grand Avenue, is in charge of Cooper H. Allen, who, before his promotion to Kansas City, was connected with the Chicago offices of the McWane interests.

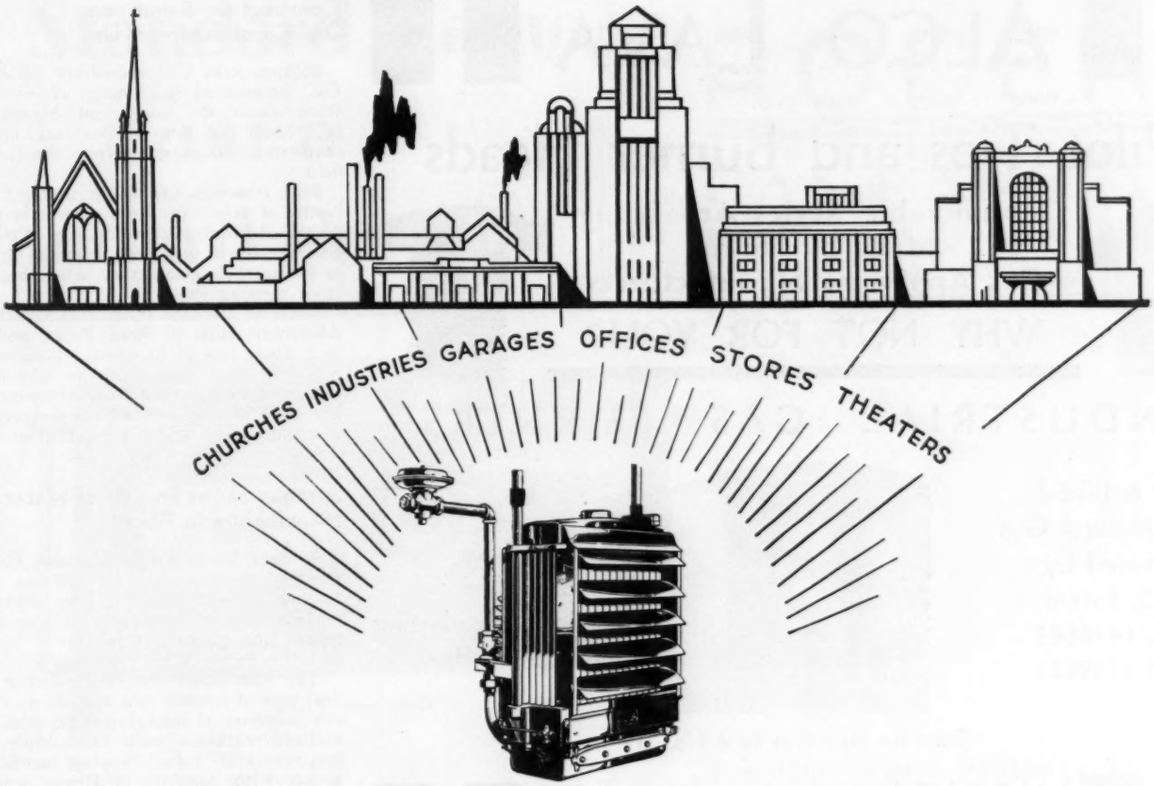
Brockschmidt Accepts Post With Mississippi River Fuel Corp.

C. L. Brockschmidt, associated for the past 4 years with the Lone Star Gas Corp., Dallas, Texas, as combustion engineer, has resigned to accept a position with the Mississippi River Fuel Corp., St. Louis, Mo.

Since the introduction of natural gas in Council Bluffs, Iowa, Mr. Brockschmidt has been in charge of all industrial work in the latter city.

C. B. Shaklee to Manage Western Gas Co. of Washington

C. B. Shaklee, general manager of the Western Gas Co., of Washington, headquartered at Salina, Kan., has taken up his residence at Longview, Wash., and will manage the properties of the company from the office of the company there. Western Gas Co., of Wash., is subsidiary to the Public Utilities Investment Co., Salina, Kan.



GAS UNIT HEATERS
Open Vast New Markets for You

YOU'VE watched, of course, the modern trend to unit heating---but it remained for The General Gas Light Company to give this trend real significance to you as a gas producer.

HUMPHREY
GAS UNIT HEATER

The Humphrey Gas Unit Heater, typically fine in design and construction, now enables you to get real production profits from industrial plants, retail stores, garages, churches, schools and theaters.

Gas unit heating requires merchandizing---but not much. The advantages and economies of gas are well known in most communities---and our heating engineers give full cooperation in preparing specifications and estimates.

Write for this interesting booklet about the possibilities in gas unit heating and Humphrey Gas Unit Heaters.

General Gas Light Company
Kalamazoo, Michigan

C. B. Babcock, Pacific Coast Manager, 135 Bluxome St., San Francisco

A HUMPHREY PRODUCT

ALCO LAVA

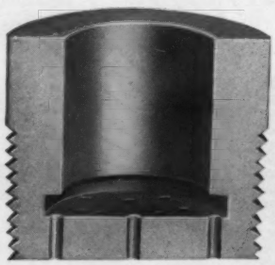
Pilot Tips and Burner Heads

Innumerable Styles Are Being Made by Us for Gas Appliance Manufacturers

WHY NOT FOR YOU?

INDUSTRIAL GAS BURNERS

For Artificial or Natural Gas Covered by U. S. Patent No. 1498644 and 1769821



Lava
Non-Corrosive
Unchangeable
Practically Everlasting
Cheaper—Better

Send for New Gas Book No. 31

AMERICAN LAVA CORP'N
1431 Williams St. Chattanooga, Tenn.

The Trend is Toward THE MASTER COAT

More and more of the men responsible for results are adopting NO-OX-ID. Why consider inferior protection and hasten the coming of reconditioning work when NO-OX-ID is available?

Estimates and recommendations supplied gladly.

Dearborn Chemical Company
LOS ANGELES:
807 Mateo Street Phone TRinity 3385
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421 Bryant Street Phone DAvenport 658

NO-OX-ID
IRON-RUST
The Original Rust Preventive

Flexible Leak-Proof

Victaulic

Pipe Couplings

Distributed by

DUCOMMUN CORPORATION

Los Angeles - San Francisco

Construction Begun on Dry Creek-Bozeman Line

Billings Gas Co., subsidiary of Ohio Oil Co., announced beginning of construction work about the middle of March on its $2,500,000 gas line to Bozeman and other southern Montana cities from the Dry Creek field.

Pipe crossings are being dredged for the laying of pipe with river clamps in the beds of the Boulder, Stillwater, and Yellowstone rivers. River crossings are being rushed to insure their completion before high water from melting snows.

Route of the line runs from Dry Creek to Absarokee, then to Reed Point, and thence in a direct line to Bozeman. Columbus, and possibly other towns of the vicinity, will be served by a branch from Absarokee. Pipe has already been ordered for the project and line completion is dated for fall months.

Sprague Shows Process of Meter Manufacture in Films

Sprague Meter Co., Bridgeport, Conn., has recently brought out two 400-foot reels of 16 mm., non-inflammable, films depicting the manufacture of Sprague cast iron gas meters. The pictures were made under the direction of the plant engineer.

The film starts with the pouring of several tons of molten iron and shows the various processes of manufacturing with its specialized machines, such as multiple drillers, tappers, and valve lapping machines, together with batteries of Brown and Sharp automatics and straight line conveyorized systems.

These films are available to public utility companies, meter and engineering schools, etc., on loan, requests to be addressed to the company at Bridgeport, Conn.

Cummins, Hagenah and Flynn to Act as Byllesby Counsel

Announcement has been made of the formation of the law firm of Cummins, Hagenah and Flynn, which will act as counsel for Standard Gas and Electric Co., and the public utility properties comprised in its system, as well as for H. M. Byllesby and Co. The firm of Cummins, Roemer and Flynn, which has heretofore acted in this capacity, has been dissolved through the retirement of John H. Roemer and Dennis T. Flynn. The offices of the firm are located at 231 South La Salle Street, Chicago, Ill.

A. G. A. Gas Co. Members To Compete for Insull Award

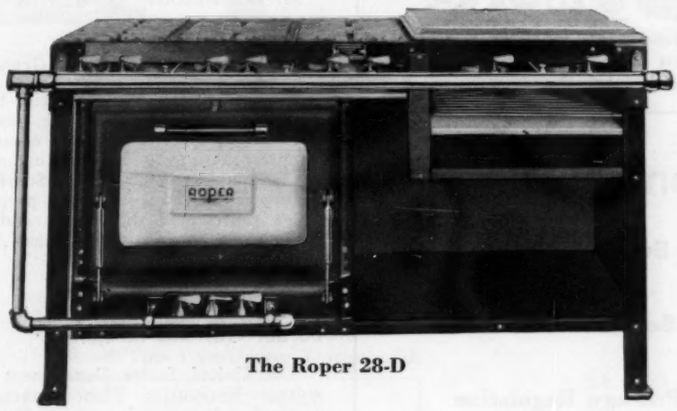
Gas company members of the American Gas Association are invited to compete for the First Annual Insull Award for Distinguished Public Service, made possible by the cooperation of Samuel Insull of Chicago, Ill. The award will be for outstanding progress during the three-year period ending with 1931, and will be presented at the 1932 convention of the American Gas Association.

Humphreys to Have Charge of Customer Ownership Activities

J. M. Humphreys has been placed in charge of the customer ownership department of the Montana-Dakota Power Co., at Rapid City, So. Dak. Mr. Humphreys formerly represented the Associated Gas and Electric Co., at Sioux Falls, S. D., working with the Sioux Falls Gas Co.

A Standard Name on a Standard Product:

ROPER
GAS RANGES
GAS FURNACES



The Roper 28-D

For Hotels and Restaurants

The Roper 28-D for short order houses and small restaurants is just one of the ranges that have made the name Roper a standard of comparison with which every chef is familiar,—a best seller of a line ranging from boarding house and small restaurant ranges up to heavy duty hotel kitchen equipment.

Designed and constructed to a standard, Roper equipment allows for great flexibility in equipping a kitchen. Ropers can be set up in single oven sections or in batteries of two or more sections, all connected into one solid unit.

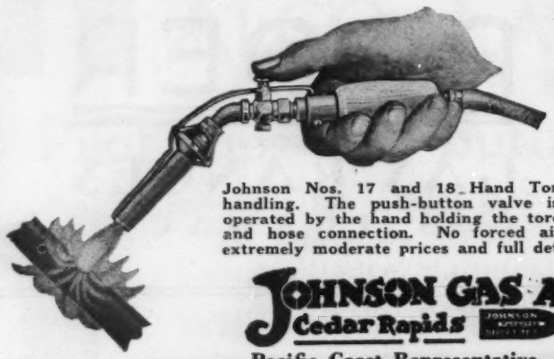
There is a Roper range for every requirement. And the entire line is made for natural gas—butane gas—bottled gas or manufactured gas.

FORTY-FIVE YEARS OF BUILDING GAS RANGES IS BACK OF EVERY ROPER PRODUCT

ROPER
GAS RANGES
GAS FURNACES

Geo. D. Roper Corporation, Rockford, Ill.

C. B. Babcock Co.
Pacific Coast Branch
135 Bluxome St.
San Francisco



Johnson Hand Torches Provide Every Desirable Feature

Johnson Nos. 17 and 18 Hand Torches are balanced for easy handling. The push-button valve is conveniently placed to be operated by the hand holding the torch. Equipped with pilot light and hose connection. No forced air blast required. Write for extremely moderate prices and full details.

JOHNSON GAS APPLIANCE CO.
Cedar Rapids IOWA

Pacific Coast Representative—C. B. BABCOCK CO.
135 Bluxome St., San Francisco, Calif.

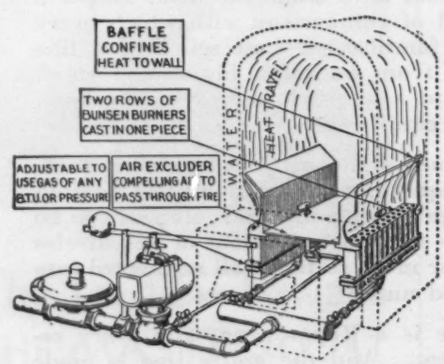
Newman Gas Equipment Co.

Industrial and Commercial Burners

Upshot Burners for Ideal Boilers

Bailey Regulators for Gas Fuel and Pressure Regulation

447 Sutter Street San Francisco Ph. GA 7833


BAFFLE CONFINES HEAT TO WALL
TWO ROWS OF BUNSEN BURNERS CAST IN ONE PIECE
ADJUSTABLE TO USE GAS OF ANY B.T.U. OR PRESSURE
AIR EXCLUDER COMPELLING AIR TO PASS THROUGH FIRE
WATER
HEAT TRAVEL

Perfect combustion correctly applied insures maximum efficiency

Noiseless, Sootless

Ideal for any size cast iron and fire-box boilers.

FAUCHER GAS BURNER, INC.
Box 5031 Dallas, Texas

STANDARD MANAGEMENT & OPERATING CORPORATION

225 Bush Street San Francisco, Calif.

PUBLIC UTILITY MANAGEMENT
ENGINEERING AND CONSTRUCTION
REPORTS AND APPRAISALS

The staff includes the following who have been associated with successful nation-wide public utility enterprises for several years past.

R. N. DREIMAN
E. F. ENGLISH JOHN COLLINS, JR. A. E. HALL
E. A. OLSEN J. B. WILSON CHAS. GRUNSKY

R. L. Grutzmacher Joins N.G.E. San Francisco Staff

R. L. Grutzmacher

APPOINTMENT of Robert L. Grutzmacher as industrial sales engineer in the San Francisco Bay territory, is announced by George Bowersox, manager of the Northern Division, Natural Gas Equipment, Inc.

Mr. Grutzmacher is well known in the gas industry of northern California, having served as industrial sales engineer with the Pacific Gas and Electric Co. for the past 4 years, after completing the training course of that company following his graduation in mechanical engineering from Stanford University in 1927. During this period he has twice represented the P. G. and E. as a speaker at Pacific Coast Gas Association conventions.

Installs Gas Burners in Border Customs Incinerator

The United States Department of Agriculture Bureau of Plant Quarantine and Control Administration at El Paso has installed a gas burner in the large incinerator at the border customs station at the Santa Fe Street International Bridge. Hereafter all fruits and vegetables which are seized by government inspectors as being forbidden from entering the United States will be destroyed in this gas fired incinerator. Gas is furnished by the Texas Cities Gas Co. of El Paso.

"Stove Style Show" Held by Union Public Service

A "stove style show" has been inaugurated in Parsons, Kan., by the Union Public Service Co., Gas Service Co. subsidiary. The show was held the evening of February 27 from 7 to 9 o'clock with more than 400 attending. The new ranges were displayed as the "new 1931 models" in much the same way the motor industry stages its auto shows. Coffee and cakes were served the guests and the women were given flowers. Small advertisements were run in the newspapers announcing the show.

Plan Construction of 25-Mile Line to Serve Five Montana Towns

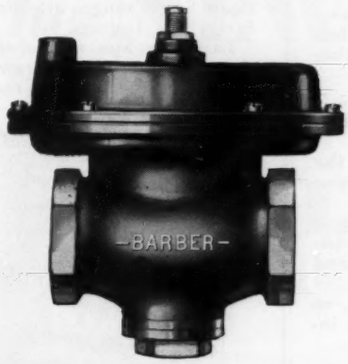
V. E. Luhrsen and associates of Great Falls, Mont., plan construction of a 25-mile line from the Arrow Creek and Pownal districts to Stanford, Mont., where a franchise has been asked. Distribution is also planned in Coffee Creek, Denton, Lewistown and Hanover. A franchise was granted in Denton on March 5.

Elect Officers of Employees Association

At the annual election of officers of the Gas Employees Association of the Louisiana Power & Light Co., New Orleans, La., the following officers were elected to serve for the year 1931: president, J. L. Andree; vice-president, A. W. Durning; secretary, J. A. Chutz; treasurer, L. Guidry.

BARBER SUPERIOR GAS PRESSURE REGULATORS

A Guarantee to Your Customers Against High Gas Bills—and Good Profits for You—



Read This Convincing Testimonial.

H. C. REYNOLDS
Sanitary Plumbing—Hot Water and Hot Air Heating Metal Work
46 Wing Street
Phone Clifford 4556
New Bedford, Mass.

March 9, 1931

The Barber Gas Burner Co.,
3702 Superior Ave.,
Cleveland, Ohio.

Gentlemen:

I purchased one of your Gas Pressure Regulators from my local Supply House about two months ago. I installed it in my house to try it out.

My January bill was $.96 and my February bill $1.00. My gas bills for the last four years have been running about $3.50 per month on the average.

To say I was surprised is putting it mildly. I now intend to go out and push this regulator as I now know it will do every bit you say it will, and more in my case. I enclose a circular, one of which you sent me some time ago. Can I have some more of these circulars at your earliest convenience?

Sincerely,
Signed: H. C. Reynolds.

THE BARBER GAS PRESSURE REGULATOR IS A RELIABLE PRECISION DEVICE : :

Neat, rugged and durable, its remarkable accuracy is built in for permanence. High grade bronze valve with all brass working parts. Springs of special phosphor bronze. Diaphragms of highest grade sheepskin, specially treated to withstand normal house service gas pressures.

Barber Pressure Regulators maintain *uniform* and *constant* supply of gas to the burners, preventing incomplete combustion and *waste* of gas. Eliminates risk of failing pilot lights and puffing out of burners.

WHY NOT ORDER A SAMPLE BARBER REGULATOR NOW TO PROVE THE MERITS OF THIS PROFITABLE BUSINESS BUILDER?

Consumer literature, sales helps and DISCOUNTS WILL BE SENT TO YOU, UPON REQUEST. *WRITE TODAY!*

Create GOOD WILL by installing Barber Pressure Regulators on house service gas lines.

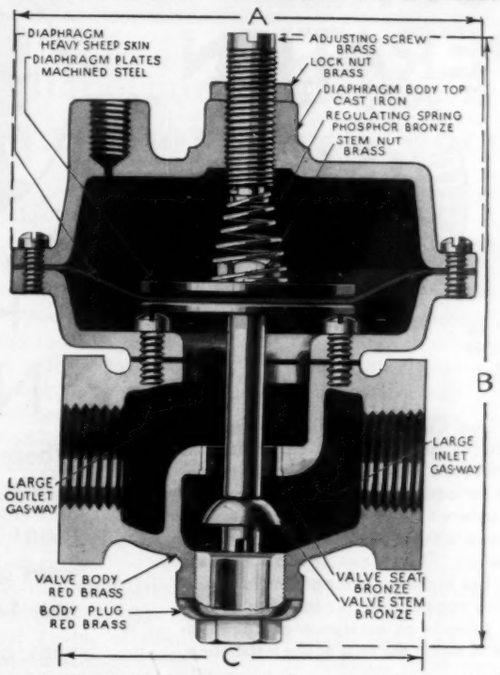
These facts will cause your customers to make the small investment that will give them this new Barber Gas Regulator Economy.

SAFETY—They provide safety from high and irregular gas pressures that produce fumes and poisonous unburned gases.

ECONOMY—They prevent waste of gas, quickly paying for themselves through lower gas bills.

SERVICE—They assure more satisfactory service from all Gas Appliances served by the meter.

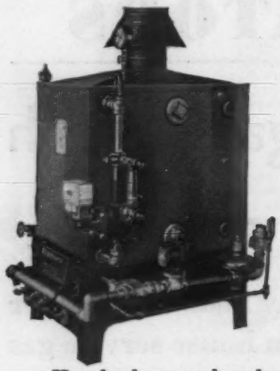
NOTE THESE SUPERIOR FEATURES:



Sizes: ¼, ⅜, ½, ¾, 1 and 1¼ inch made with brass bodies.
Sizes: 1½ and 2 inch made with iron bodies and brass seats.

THE BARBER GAS BURNER CO.

3702-3704 Superior Ave.
CLEVELAND, OHIO



The Pittsburg A Famous Boiler

The crowning engineering achievement in the gas boiler industry has been the design and perfection of the famous "Pittsburg" Boiler, the most advanced gas-fired house-heating boiler of the day.

Hundreds upon hundreds of installations have definitely proven the superiority of the "Pittsburg," achieving a fame that is rapidly spreading to all parts of the country.

Back of the design and construction of the "Pittsburg" Boiler rests the manufacturing resources of the worlds' largest water heater manufacturers—The Pittsburg Water Heater Company.

The "Pittsburg" label on these boilers is your assurance of the highest mechanical and engineering perfection, a service organization that extends into every town and city of any importance in the land, and an iron-bound guarantee of proven dependability.

Just as "Pittsburg" Water Heaters have demonstrated their superiority, so you will find "Pittsburg" Boilers rendering unsurpassed service wherever installed.

Write for booklet, prices and discounts.

"Efficient House Heating With Gas."
"Pittsburg House Heating Boilers."

Pittsburg Water Heater Company
Factory and General Office: Pittsburgh, Pa.
Offices in all principal cities.

ASSURED OPERATION

COMBUSTION EQUIPMENT · LEAHY · LOS ANGELES CAL. U.S.A.

WHEN THE POWER FAILS PRODUCTION STOPS

LEAHY Dual Combustion Furnaces are designed to guard against the failure of heat generated power. Leahy Units are equipped for both gas and oil, and one fuel can be replaced with the other at a moments notice without loss of time or change in efficiency. These gas and oil burners represent the highest development in industrial heating engineering . . . together in one unit they provide an assurance of operation that alone is worth the cost of the installation.

◆

LEAHY MANUFACTURING CO
Established 1902
1804-1812 East Eighth Street, Los Angeles, California
E. A. CORNELY INC.
1452 Bush Street, San Francisco, California

NEW YORK'S NEW

HOTEL LINCOLN

Where modern scientific planning and management make possible rates surprisingly moderate. 1400 Rooms, each with bath and shower.

$3-5 For One $4-7 For Two

Telephone Lackawanna 1400

Eighth Ave., 44th, 45th Sts.
Times Square · NEW YORK

Moore Brothers Co. Announces New Line of Gas Ranges

Moore Brothers Co., Joliet, Ill., manufacturer of Moore's Puritan gas heater, has recently announced a new line of gas ranges, embodying several new developments.

Featured in the line are ranges of the buffet type, finished in two-tone tapestry porcelain enamel. In this new trim harmonious tones of green and old ivory are blended in a unique way to form a distinctive finish. Kitchen heater and bungalow ranges are also available in two-tone tapestry.

Moore's "Super-Insulated" gas range, and the 4 Series ranges are shown with a number of new features.

Last year Moore Brothers Co. introduced the Hi-lo-See broiler drawer in its line of ranges. A number of changes have been

Moore's service gas range in two-tone tapestry finish.

made in this device. The drawer glides in and out on roller bearings, and the smokeless and spatterless broiler pan may be raised or lowered by turning the handle on the drawer front.

All the company's new ranges have main front, doors and general construction of cast iron. Three finishes are available—two-tone tapestry, "Verduro" and ivory, and French gray and ivory. These ranges are shown and described in a brochure recently issued, which may be obtained on request to the company.

Three More Towns Scheduled for Coast Counties Service

Danville, Diabalo and Alamo, Calif., in the Contra Costa district, will be served through a line extension planned by Coast Counties Gas & Electric Co., Santa Cruz, Calif., according to Frank Thomas, Contra Costa manager for the company. The new gas line will extend from Walnut Creek to serve the towns.

W. H. Gardner on Staff of Electrogas Furnace Co.

William H. Gardner has recently joined the staff of the Electrogas Furnace Co. as a sales representative out of the Oakland office.

Both wholesale and retail headquarters of the Electrogas in Oakland are in the new office and display room at 512 17th Street.

Deepwater Franchise Voted

Deepwater, Mo., has granted a natural gas franchise to the Western Service Corp., of Oklahoma City, Okla.

The NEW *Improved* ELECTROLUX *offers*

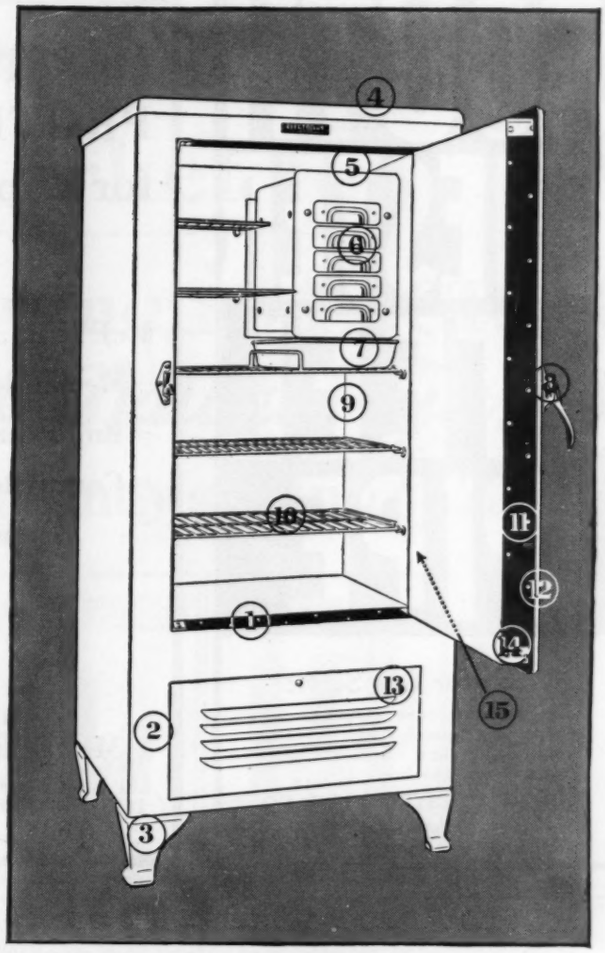
5 Additional Models
15 New Features

WE couldn't improve the simple, reliable Electrolux principle—but we've made the cabinets more luxurious than ever. Fifteen new, practical features have been added to Electrolux, the Gas Refrigerator. Check them over and see how the new Electrolux is better built, better looking than ever before. Housewives, prospects, can see and understand these features. They are the things that will make gas refrigeration more popular than ever, that will help you increase gas consumption in your territory.

The new models will help, too. Five new household and *commercial* models have been added to the eight regular household types. Among the newcomers are a special buffet box—called the "Westchester"—an ice-cream cabinet, and a storage refrigerator. Every grocery, delicatessen, club, dairy is now a prospect for gas refrigeration.

Sales Helps Ready Now

Catalogues, newspaper announcements, and a carefully worked out plan to secure apartment house business (Plan A) are waiting for you. Your first step in the drive for gas refrigeration business this year is to write, wire or telephone for this sales information. Address Electrolux Refrigerator Sales, Inc., Evansville, Indiana.



15 Important Features of the NEW IMPROVED ELECTROLUX

1. Panelite door frame trim with chromium-plated screw heads.
2. Exterior of standard Electrolux quality.
3. New artistic all-white legs. Easy to clean under cabinet with broom or mop.
4. Smooth, flat top. Used for table-top or dish storage.
5. Good-looking Chilliator assembly, porcelain covered.
6. Individual, self-sealing tray fronts of chromium. Cannot rust.
7. Practical chill tray arrangement. Gives more shelf room, eliminates waste of storage space.
8. Trigger-snap door latch of chromium plate. Facilitates opening and closing of door.
9. Beveled corners inside . . . easy-to-wipe porcelain lining. Makes cleaning easy.
10. Ribbon-type shelves. Prevent bottles and dishes from tipping over.
11. Panelite door trim with chromium screw heads.
12. Improved long-life gaskets.
13. Automatic gas lighter.
14. Chromium-plated hinge—brass door corners and door-frame corners.
15. Chromium-plated hinges in modern relief design.

ELECTROLUX

THE *Gas* REFRIGERATOR

SOUTH CHESTER STEEL PIPE

Excels for Gas Service

The unusual care given to accuracy of diameter and welding qualities, makes Chester Pipe a favorite for gas lines.

SOUTH CHESTER TUBE CO.
Chester, Pa.

DEPENDABLE PROTECTION for Pipe Lines

McEVERLAST Coatings
+Mechanical application
+Engineering service
=Complete,
Dependable
Protection

McEVERLAST, Inc.
111 West 7th St. Russ Building
LOS ANGELES SAN FRANCISCO

IMUNOL

Reg. U. S. Pat. Office
U. S. and Foreign Patents Granted

WILLIAMS
GAS STEAM RADIATOR

Made in 22 sizes from 26 to 180 feet of rating.

IMMEDIATE HEAT AUTOMATIC LIGHTER

Improved Combustion. Positive Gas Control.

Write for descriptive matter and prices.

WILLIAMS RADIATOR COMPANY
1865-1873 Cordova St. Los Angeles, Calif.

One agent wanted in each of several cities.

Victor Welding Equipment and Kimball-Krogh Pump Merge

Victor Welding Equipment Co., with headquarters and plant at San Francisco, Calif., maker of welding and cutting equipment, and the Kimball-Krogh Pump Co., with plants at Los Angeles and San Francisco, have been merged into the Victor Equipment Co. Both Victor welding equipment and Kimball-Krogh pumps will continue to be sold under their own trade marks and the two companies will be operated as individual divisions by the newly formed organization.

The object of this merger is to strengthen the engineering and research facilities; to enlarge the domestic and foreign sales fields; to consolidate and expand warehousing, trucking, and delivery service.

Since 1877 pumps of the Kimball-Krogh division have been marketed internationally. The line includes deep well turbines, horizontal centrifugals, booster and circulating pumps.

Victor Equipment Co. will be under the management of L. W. Stettner, president; E. L. Mathy, vice-president in charge of sales promotion and advertising; Geo. Pennington, vice-president and general manager of the Kimball-Krogh division; Ronald Schlegel as vice-president and assistant to Mr. Pennington, and Wm. Fulwider, secretary, in charge of accounting.

Council Bluffs Gas Co. Fires Incinerator With Natural Gas

The Council Bluffs Gas Co., Council Bluffs, Iowa, recently completed a natural gas installation at the city incinerator plant, which consists of retort-type incinerators with a manufacturer's rated capacity of 22 tons of garbage daily. The retorts have been fired in the past with coal at three different points. The main firing chamber was a Dutch oven with two smaller firedoors on sides of the retort.

Fifteen-pound pressure gas burners were installed which, according to tests already made, will nearly double the working capacity of each retort.

Loomis Accepts Post with Pittsburgh Water Heater Co.

W. G. Loomis, for several years assistant sales manager of the Oklahoma Natural Gas Corp. Merchandise Department, Tulsa, Okla., has resigned to accept a position with the Pittsburgh Water Heater Co.

Mr. Loomis will have charge of the sale of water heaters to the Pittsburgh group of the Columbia Gas and Electric Co., and will make his headquarters in Pittsburgh, Pa.

Harkins Goes With Panhandle Eastern P. L. Co.

R. B. Harkins, meter inspector for the Oklahoma Natural Gas Corp., Tulsa, Okla., has announced his resignation in order to accept a position with the Panhandle Eastern Pipe Line Co., Kansas City, Mo. Mr. Harkins had been with the Oklahoma Natural for 7 years. He will make his new headquarters in Fritch, Texas.

McCleod Oil Co. to Serve in Turner Valley

McCleod Oil Co., Ltd., has been granted a franchise for the service of natural gas in the town of Turner Valley, Alberta.

Why *Natural Gas* is Increasing the Dealers' Market for gas appliances

It is fine to tell people that Natural Gas saves money.

But that is a general and not necessarily convincing statement. People are convinced by specific figures. That is why it is much better to tell them in dollars and cents just what the saving has amounted to.

That is what we have done in the recent newspaper advertisement reproduced here. And the facts which it contains are mighty helpful to everyone who sells gas appliances—especially gas heating appliances.

In this advertisement the fact is published that San Francisco, East Bay and San Jose consumers realized a total saving of $4,209,000.00 during June to November inclusive, 1930.

The percentage of savings which are made for the people in this territory are typical of the savings made by people in other sections of our Natural Gas territory.

Consequently, thousands of homes, apartment houses, and commercial buildings are changing their heating equipment to use Natural Gas. A new market has been created for gas appliances of all types.

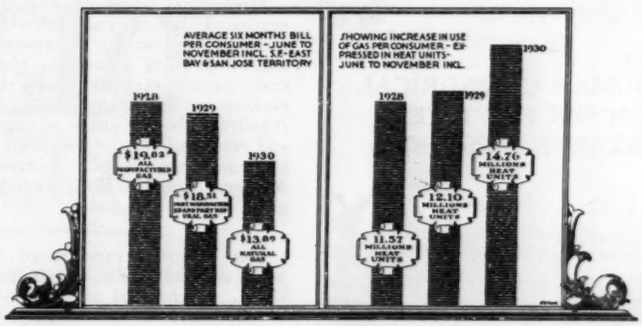
As previously announced, our regular appliance advertising is designed to tell people WHY they should buy gas appliances.

The wise local dealer will run an advertisement beside this Company's and tell prospects WHERE they can buy these appliances.

PACIFIC GAS AND ELECTRIC COMPANY
P·G·and E·
Owned·Operated·Managed
by Californians

252-431

Convincing FACTS about *Natural Gas* as a money saving *FUEL*


AVERAGE SIX MONTHS BILL PER CONSUMER - JUNE TO NOVEMBER INCL. S.F.-EAST BAY & SAN JOSE TERRITORY
1928
1929
1930
$19.82 ALL MANUFACTURED GAS
$18.51 PART MANUFACTURED AND PART NAT. GAS
$13.89 ALL NATURAL GAS
SHOWING INCREASE IN USE OF GAS PER CONSUMER - EXPRESSED IN HEAT UNITS - JUNE TO NOVEMBER INCL.
1928
1929
1930
11.57 MILLIONS HEAT UNITS
12.10 MILLIONS HEAT UNITS
14.76 MILLIONS HEAT UNITS

EVERY one knows that Natural Gas has reduced fuel costs. But we wanted to know the actual amount it saved consumers in a six months' period. So we put accountants and other experts to work comparing the gas bills for the first six months of Natural Gas Service, June to November—1930 with 1929 and 1928. This is what we found:

In the San Francisco, East Bay and San Jose territory, Natural Gas cut the gas bills of our consumers for those six months of 1930 by $2,209,000.

More than that! Customers who saved this money used 27.6 per cent more heat units, obtaining greater comfort or replacing other fuels with a further saving in fuel costs.

Had these additional heat units been charged for at the 1928 rates for manufactured gas, customers would have had to pay another $2,000,000 in gas bills.

So the total saving was $4,209,000.

The saving is still going on—it was greater in the cold winter months of December and January than in the June to November period.

Glance at the graphs at the head of this advertisement.

Note that in 1928 the average consumer paid $19.82 from June to November for manufactured gas. In the same period in 1929 he paid only $18.51 for part manufactured and part natural gas. In 1930, when he had full service of natural gas, his bill for the six months dropped to $13.89.

The other column shows how heat units went up as bills went down—11.57 million heat units was the average use per consumer for six months in 1928; 12.10 million in 1929; 14.76 million in 1930.

Dollars saved from one source are dollars available for spending in other places. Millions saved in gas bills go to purchase other commodities—circulate through other channels of trade—create more jobs and more employment.

Natural gas is a money saver for the individual consumer; a prosperity builder for the community.

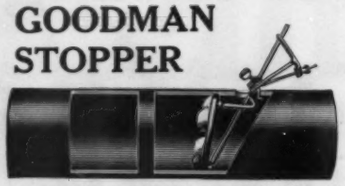
PACIFIC GAS AND ELECTRIC COMPANY
P·G·and E·
Owned·Operated·Managed
by Californians

252-321

"Another Sign of Progress"

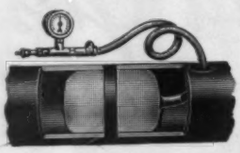
The actual size of the advertisement reproduced above is 5 columns by 19 inches. This advertisement appeared in San Francisco Bay Area newspapers . . . . which reach out into all the territory where Natural Gas is served.

THE
GOODMAN
STOPPER



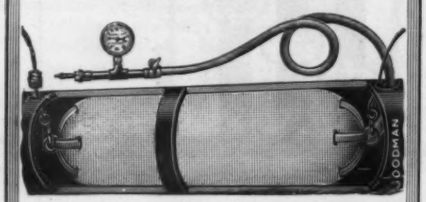
WHEN LOCKED IN PLACE IT HOLDS

DEPENDABLE GAS
MAIN BAGS



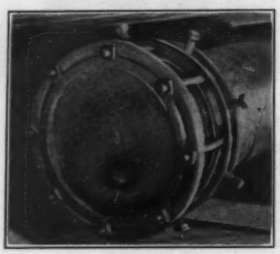
Type C

GOODMAN CYLINDRICAL
STOPPER FOR INTER-
MEDIATE PRESSURE



Increased Length for Increased Pressure

KRUPA-HENDRY
TEST CAP



For Testing High Pressure Lines

SHIPMENTS FROM STOCK

SAFETY GAS MAIN
STOPPER COMPANY

523 Atlantic Avenue
BROOKLYN, N. Y.

Pac. Coast Rep.: C. B. Babcock Co.
135 Bluxome Street, San Francisco
California

CLASSIFIED ADVERTISING

Classified advertising five cents per word; minimum $2.00 per insertion. Situation Wanted advertisements up to 50 words will be published three consecutive issues without charge.

HELP WANTED

Manufacturer's representatives wanted to handle well known line of circulating cabinet heaters. Have interesting proposition for representatives who have had experience in handling this type of equipment. Address Box B-108, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

SITUATIONS WANTED

Mechanical engineer and draftsman, experienced laying out, drawing plans and specifications for gas compressor stations and natural gasoline absorption plants; also several years executive experience, desires position with company needing qualified man. Applicant is 29 years of age. References and record of experience gladly given. Available on short notice. Address Box E-111, *Western Gas,* 124 West Fourth St., Los Angeles, Calif.

Gas engineer, experienced in commercial boiler and industrial kiln operation, seeks position. Mechanical and technical knowledge of fuel measurement supply, diffusion and consumption. Past three years sales and engineering of measurement and control devices to industrial consumers in Mid-Continent states. Address Box E-113, *Western Gas,* 124 West 4th Street, Los Angeles, Calif.

Gas compressor station engineer desires connection in West or Mid-West section. Applicant is 25 years old; married; has college education in engineering; has helped erect four natural gas compressor stations, 720 to 10,000 H.P.; and has been employed in these after completion without loss of time for 4½ years. Address Box E-109, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Man experienced in gas distribution desires position. Applicant is 29 years of age, has had 11 years' experience in consumers' complaints, installations and servicing, both industrial and domestic. Can furnish references. Experience has been in natural, manufactured and butane gas. Address Box E-115, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Auditor experienced in all branches of public utility accounting desires connection on West Coast. Applicant is 38 years old and has had 16 years accounting and statistical experience. Also qualified for office management or treasury department work. Now employed in Mid-Continent field in natural gas accounting. Address Box E-125, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Electrical and mechanical engineer with over 12 years experience in design, development and construction of heating appliances and automatic controls pertaining to same, familiar with shop practice and supervision of manufacturing as applied to the gas industry, seeks position. Address Box E-121, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Superintendent of measurement and distribution of natural gas desires new connection. Thirteen years experience in all branches of the gas industry, including production, transportation, measurement and distribution, both domestic and industrial. Technical graduate, employed at present. Married. Address Box E-123, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Distribution Engineer, age 34, with 8 years experience in designing, operating and maintaining distribution systems, desires managerial connection with small gas company or operating unit. Thoroughly conversant with technical and supervisory procedures, and well qualified in accounting and commercial practices. Responsibly employed at present with large western utility. Address Box E-117, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Appliance and service man familiar with change-over work desires position in gas company in California, Washington or Oregon. Has had experience on the Denver change-over, also at Salt Lake City and Springfield, Ill. Address Box E-119, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif.

Experienced gas meter repairman desires position. Has had three years experience in repairing large and small capacity meters, both tin and iron case. Address Box E-127, *Western Gas,* 124 West Fourth Street, Los Angeles, Calif

To Spend $150,000 on Additions and Improvements

Northwest Cities Gas Co., headquartered at Walla Walla, Wash., plans expenditures of $150,000 during the coming year, according to Howard M. Thomas, general manager of the company. Equipment will be added to the plants owned by the company in Astoria, Pendleton, Eugene and Springfield, Ore.; Yakima and Walla Walla, Wash., and Lewiston, Idaho.

Petroleum Heat and Power Co. Opens San Francisco Office

The Petroleum Heat & Power Co. has opened new offices in San Francisco at Van Ness Ave. and Jackson St., where it will sell at retail gas and oil burning appliances, including furnaces, water heaters, conversion burners, space heaters and circulators.

A. E. MacInnis is vice-president and general manager. Offices are being maintained at Oakland, San Mateo, and at 455 E. 3rd St., Los Angeles.

STOP Installation Costs and "Service Calls" that Eat Profits

Simply, easily done—just concentrate on the ONE line of radiant gas heaters that is UNIQUELY ENGINEERED to cut your overhead costs—

RAY-VITALITE-GLO

Radiant Gas Heaters

The way Ray-Glo is MADE, makes it mighty easy and quick to install—even in the tightest-fitting fireplace. You save $1, $2—or more!—on labor, compared to the cost of installing the ordinary radiant heater. If you don't know about this, let us show you.

No waiting on the job for the heater to warm up, for "adjustment"—No "service calls" afterwards—

The FIXED mix, built-in, ALWAYS right, makes all such entirely uncalled for! Your net profits will profit.

New values now that challenge any competition.

New models—down where low prices BEGIN

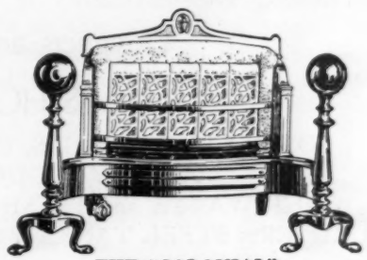
New sales helps—to help you build VOLUME

Buy NO radiant heaters until you have details

Write or Wire For Them Today

THE "TEXAN"

THE "HARTFORD"



THE "COLONIAL"

THE "CHIPPENDALE"

RAY-GLO CORPORATION, Athens, Ohio

United Gas Public Service Buys Lake Charles Gas Plant

Negotiations which culminated in an agreement to purchase the Lake Charles, La., gas plant and city distribution system from the Gulf States Utilities Co. were announced by the United Gas Public Service Co., a unit of the United Gas System.

Purchase of the Lake Charles system will make that city headquarters of the entire division to be served by the new pipe line now under construction in southwest Louisiana. D. S. McManus, division manager, already has temporary headquarters in Lake Charles.

The Lake Charles system will be taken over officially when natural gas is available for distribution throughout the city about July 1.

As soon as the necessary legal steps have been taken to close for the purchase of the gas property, engineers of the United Gas Public Service Co. will be put in the field to develop plans for enlarging the system, making it ready for the distribution of natural gas. It is estimated that the cost of the improvements at Lake Charles will be nearly $100,000.

Jones Interests Buy Carlton Pipeline and Winchester Gas Co.

The Nathan L. Jones interests have announced the purchase of the capital stock of the Regina Gas Co., operating in several southern Kansas and northern Oklahoma towns and cities. The Regina company owned controlling interest in the Carlton Pipeline Co., and the Winchester Gas Co., owning and operating the distribution systems of Woodward, Alva, Waynoka, Cherokee, Mooreland, Hardtner, Quinland and Avard, Okla. Purchase price paid by the Jones interests is said to be around $1,000,000.

Byllesby Engineers in Sixth Annual Conclave

The sixth annual convention of the engineering department of the Byllesby Engineering and Management Corp., Chicago, Ill., was held March 24 and 25 in the Bal Tabarin of the Hotel Sherman in Chicago.

The convention sessions were presided over by H. W. Fuller, vice-president in charge of engineering and construction. Speakers include John J. O'Brien, president of the company, and R. J. Graf, first vice-president, together with others, presenting technical discussions concerning the various phases of the company's engineering and construction operations.

Changes in Doherty Subsidiaries New Business Departments

Roy Bledsoe, new business manager of the Union Public Service Co., Fort Scott, Kan., has accepted a position as sales supervisor with the Kansas City Gas Co., Kansas City, Mo. Mr. Bledsoe takes the position left vacant by the transfer of R. O. Pitman to the post of new business supervisor of the St. Joseph Gas Co., St. Joseph, Mo. Mr. Bledsoe's position at Fort Scott has been filled by Robert Brosius.

L. L. Meier Affiliates With American Stove Co.

L. L. Meier, formerly sales supervisor for the San Joaquin Valley Division of the Southern California Gas Co., headquartered in Los Angeles, has joined the sales force of the American Stove Co. Mr. Meier will travel the San Joaquin Valley, as well as San Jose and Santa Cruz territories, for the above organization, and will maintain headquarters in San Francisco.

Peoples Gas Co. Completes Line to St. John and Stafford

The Peoples Gas Co., headquartered at Tulsa, Okla., recently completed construction of a 6-inch line from the main line of the Public Service Co. of Kansas to serve St. John and Stafford, Kans. The extension leaves the main line at a point near Pratt. J. W. Shenefield is general manager for the company.

White Water Scheduled for "Natural" Service Soon

White Water, Kan., was expecting to see the beginning in March, of construction of its distribution system for the service of natural gas from the Panhandle-Eastern Pipe Line Co.'s major carrier from Texas fields to metropolitan centers in Indiana.

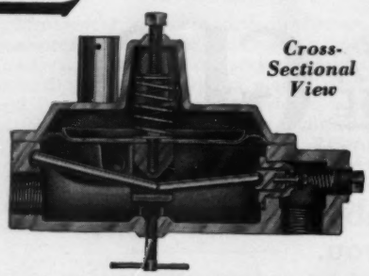
Prichett, Colo., Gas Franchise to Colorado Gas and Utilities

Colorado Gas and Utilities Co., Denver, has been granted a natural gas franchise in Prichett, Colo. Supply will come from the recently completed line from the Hugoton, Kan., gas area to Lamar and other cities in eastern Colorado and western Kansas.

Reynolds
Gas Control Since 1892

Reynolds Little Giant Regulator

Products for all kinds of Pressure Reduction—for either artificial or natural gas.
GOVERNORS—Intermediate Pressure, Triple Outlet, Holder, Toggle Type Street.
REGULATORS—High Pressure Service, Low Pressure Service, High Pressure Line, Single and Double District Station.
VALVE—Automatic Quick Closing Anti Vacuum.



Cross-Sectional View

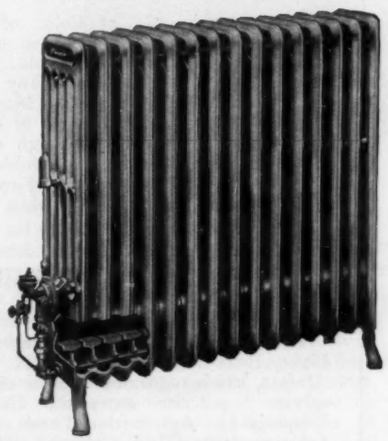
Reynolds Gas Regulator Company
Anderson, Indiana

The BARTLETT HAYWARD CO.
Designers and Builders
GAS HOLDERS
COMPLETE COAL GAS, CARBURETTED WATER AND BY-PRODUCT PLANTS
SALT WATER and FRESH WATER CONDENSERS
PURIFIERS, STEEL TANKS, FELD VERTICAL SCRUBBERS
Main Office and Works Baltimore, Md.
Lincoln Building New York City

Gentlemen:
Kindly send me a sample can and full details regarding
A-B Vit
The New Porcelain Enamel Cleaner
Name.....
Company.....
Address.....
No obligation, of course
Clip and mail today to
A-B STOVE CO., Battle Creek, Mich.

Announcing THE NEW VENTED PACIFIC GAS-STEAM RADIATOR

Beautiful new design Pacific Gas-Steam Radiators come in two different heights, and in as many sections as required.



The HEALTHY CONSTITUTION OF A SPLENDID RADIATOR

Cut-out shows improved Multi-Tubular burners, exclusively developed by Pacific Gas Radiator Co., the Automatic Safety Control, Steam Pressure Safety Valve, and other details of the new *vented* Pacific Gas-Steam Radiator.

Welcome news for the Western Gas Industry . . . a new, greatly improved, *vented* Pacific Gas-Steam Radiator.

Product of the West's largest organization of gas heating specialists . . . heir to all the prestige and good will won by more than 250,000 Pacific Gas installations in the West . . . attractive, efficient, economical . . . easy to install . . . permanently adjusted and service-free.

Safety Burner Control . . . Automatic Lighter . . . Automatic Steam Pressure Control . . . Complete Venting of All Combustion Products . . . A.G.A. and Underwriters' Laboratory Approved.

Here is a Gas-Steam Radiator which meets every requirement for wholesome, uniform, dependable heat . . . every requirement of safety . . . every requirement of economy . . . every requirement of architectural attractiveness.

Our new Bulletin for Architects, Engineers, Builders describes the new vented Pacific Gas Radiator in detail. Important installations in the officers' quarters at Randolph Field, San Antonio, Texas, and elsewhere indicate its immediate acceptance. Let us send our Bulletin and other data for your files.

A.G.A. Approval . . . The laboratory seal of American Gas Association appears on every Pacific Gas-Steam Radiator, assurance that it has met basic national safety requirements. Also approved by Underwriters' Laboratories.

COMPLIES WITH NATIONAL SAFETY REQUIREMENTS — AMERICAN GAS ASSOCIATION — APPROVED

Pacific Gas Radiator Gas Heating Company Headquarters

Roseberry and Walter Streets
Huntington Park California

Gas-Steam Radiators

Round Furnaces

Dual Pipeless Furnace

Fireplace Radiant Heaters

Recess Radiant Wall Heaters

Automatic Storage Hot Water Heaters

Pipeless Floor Furnaces

Gas Radiators—Pressed Metal and Cast Iron

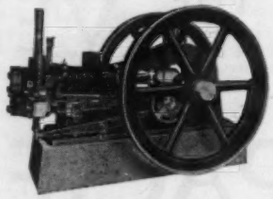
Agencies Throughout the West

Call for a Pacific Heating Engineer

MANUFACTURERS of EVERY TYPE of GAS HEATING APPLIANCE

Increase Your Industrial Load With Natural Gas Engine Power.

USED FOR:
Ice Plants
Cotton Gins
Pumping Plants
Laundries
Brick Plants
Electric Generating
Manufacturing Plants



Gas engines save over Electric Motors Steam Engines Gasoline Engines and Oil Engines. Their savings are so great you will be surprised.

WRITE US FOR FULL INFORMATION ABOUT THESE SAVINGS

CHARTER GAS ENGINE COMPANY - STERLING, ILLINOIS

Manufacturers of Dependable Gas Engines Since 1880

Single Cylinder 25 to 100 h.p. **Double Cylinder 60 to 200 h.p.**

IT'S "MATCHLESS"

Electrogas

FLOOR FURNACE

—proven economy and efficiency through ten years of service

NATURAL GAS

is creating the demand for installation in

OLD AND NEW HOMES

MADE IN SEVERAL SIZES TO MEET ALL REQUIREMENTS

Write for Attractive Dealer Proposition

ELECTROGAS FURNACE CO.
466 Sutter Street
SAN FRANCISCO, CAL.

GROBLE REGULATORS & GOVERNORS

Complete Line of Regulators for

Natural, Manufactured, Butane and Propane Gas

Pacific Coast Representative,

T. G. ARROWSMITH COMPANY,
661 Howard Street **San Francisco, Calif.**
Phone Garfield 8419

GROBLE GAS REGULATOR COMPANY
Office and Factory: Anderson, Indiana

TAPPAN

Supremacy

is not a newly-won achievement, but an old and accepted standing in the eyes of gas appliance men and the public alike. No other gas range combines so many outstanding superiorities into such a perfect whole—the TAPPAN Insulated Oven gas range.

H. R. Basford Co.
665 Howard St.
San Francisco

H. R. Mayer
1001 E. 1st St.
Los Angeles

F. W. Schwab
2512 N. Stevens
Tacoma

Rates in Great Falls, Mont., Are Reduced

A reduction in gas rates has been announced by the Great Falls Gas Co., Great Falls, Mont., effective March 1. The new schedule consists of two rates, one for consumers using less than 1,500,000 cubic feet per year and one for consumers who contract for or use more than that amount per year. This is the second reduction since August 10 of last year.

Under the new schedule the rate for the first 5,000 cubic feet is 65 cents as compared with 67½ cents under the old rate. For the next 95,000 cubic feet, the rate is 45 cents as compared with 50 cents under the old rate.

Wholesale rates available for consumers who contract or use 1,500,000 cubic feet per year or more are as follows:

		Net Per M. Cu. Ft.
First	1,000,000 cubic feet.....	.30
Next	9,000,000 cubic feet.....	.25
All over	10,000,000 cubic feet.....	.20

Line to Serve Brighton and Fort Lupton in Service by May 1

Public Service Co. of Colo., of Denver, began operations on construction of a distribution system in Brighton, Colo., about the middle of March. The company plans to begin service in the town about May 1. Supply will come from the mains of the Colorado-Wyoming Gas Co., through a 16-mile extension from a point near Louisville; this line to be continued to serve Fort Lupton, 6 miles north, where a franchise was recently granted to the company.

Canadian Western to Broadcast Home Service Talks

The Canadian Western Natural Gas, Light, Heat and Power Co., Ltd., Calgary, Alberta, has inaugurated a series of 35 home service broadcasts under the direction of Hesperia Lee Aylsworth. These radio talks are given over CJCJ, Calgary, at 1:45 p.m., mountain standard time, each Friday on a wave length of 434.5 meters—690 kilocycles.

Detroit May Be Next for "Natural"

If recent press reports are to be credited, another major industrial area may soon have natural gas at its command. News dispatches state that a 400-mile line from Ashland, Ky., to Detroit, Mich., may be laid by Moody-Seagraves interests, at a cost of 25 million dollars. Distribution would be by Detroit City Gas Co., subsidiary of American Light and Traction Co.

Safeway Stores in Vancouver Now Heated With Gas

The entire chain of grocery stores operated by the Safeway Stores Limited at Vancouver have now standardized on gas for heating their buildings. Contract for the installation has been awarded to the B. C. Electric Railway Co., Vancouver, B. C.

Mulhall Grants Gas Franchise

Mulhall, Okla., granted a 25-year natural gas franchise to the Mulhall Gas Co. in February. A part of the gas system has already been installed.

THE CLEVELAND BABY DIGGER

Runs Up High Trench Footage Runs Down High Trench Costs

MANY tests on hundreds of mighty tough jobs have proved to users in all parts of the country that the Cleveland Baby Digger will deliver maximum trench footage at minimum cost. Of course, there's a reason—many reasons.

If the job is to be done in the close, confined areas of cities and suburbs, through narrow alleys, close to or between obstructions such as hydrants, poles and fences, over soft tree lawns with the trees close together, then the extreme compactness of the Baby Digger (but 58 inches wide) and the fact that it carries no excess tonnage (weighing approximately 4 tons) assures you of fast, continuous machine digging and the elimination of practically all hand labor.

The extreme ease of transportation of the Baby Digger—it loads and unloads on its own specially built trailer in less than five minutes and travels to the next job at truck speed—makes practical and economical the use of machine digging on many short-line jobs.

The Baby Digger is amply powered for the toughest and hardest going, and sturdily and huskily built of the finest steels procurable. More machine jobs in more places at less trench cost is the performance that Cleveland Baby Diggers are regularly giving their users. Write today for catalog No. 10 giving complete specifications and full details.

THE CLEVELAND TRENCHER COMPANY

"Pioneers of the Small Trencher"

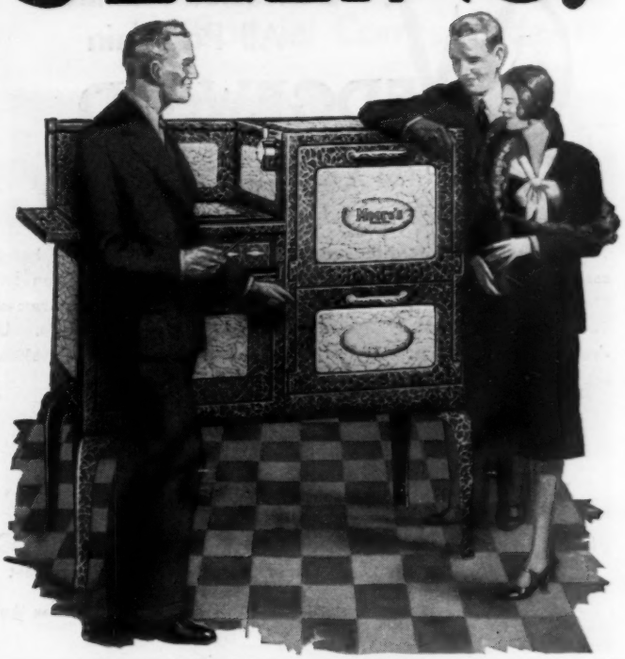
20100 St. Clair Avenue, Cleveland, Ohio, U.S.A.

Distributed by

Edward R. Bacon Co. San Francisco, Calif.
Frank T. Hickey Co. Los Angeles, Calif.

THE CLEVELAND BABY DIGGER

They Are SELLING!



The New and Distinctive

MOORE'S

Two-Tone Tapestry Gas Ranges

The reason is apparent—they are the outstanding ranges on the market today.

Besides being absolutely different in design and finish, providing a sales appeal that has no equal, Moore's Two-Tone Tapestry Gas Ranges present a staunch cast iron construction and exclusive features that defy competition. A flood of repeat orders is definite proof that they have real "selling punch."

Put a display of these ranges on your floor and in your window. They will make sales for you. Write or wire now for one or more floor samples.

MOORE BROTHERS COMPANY

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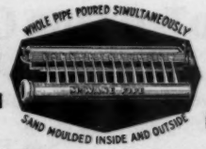

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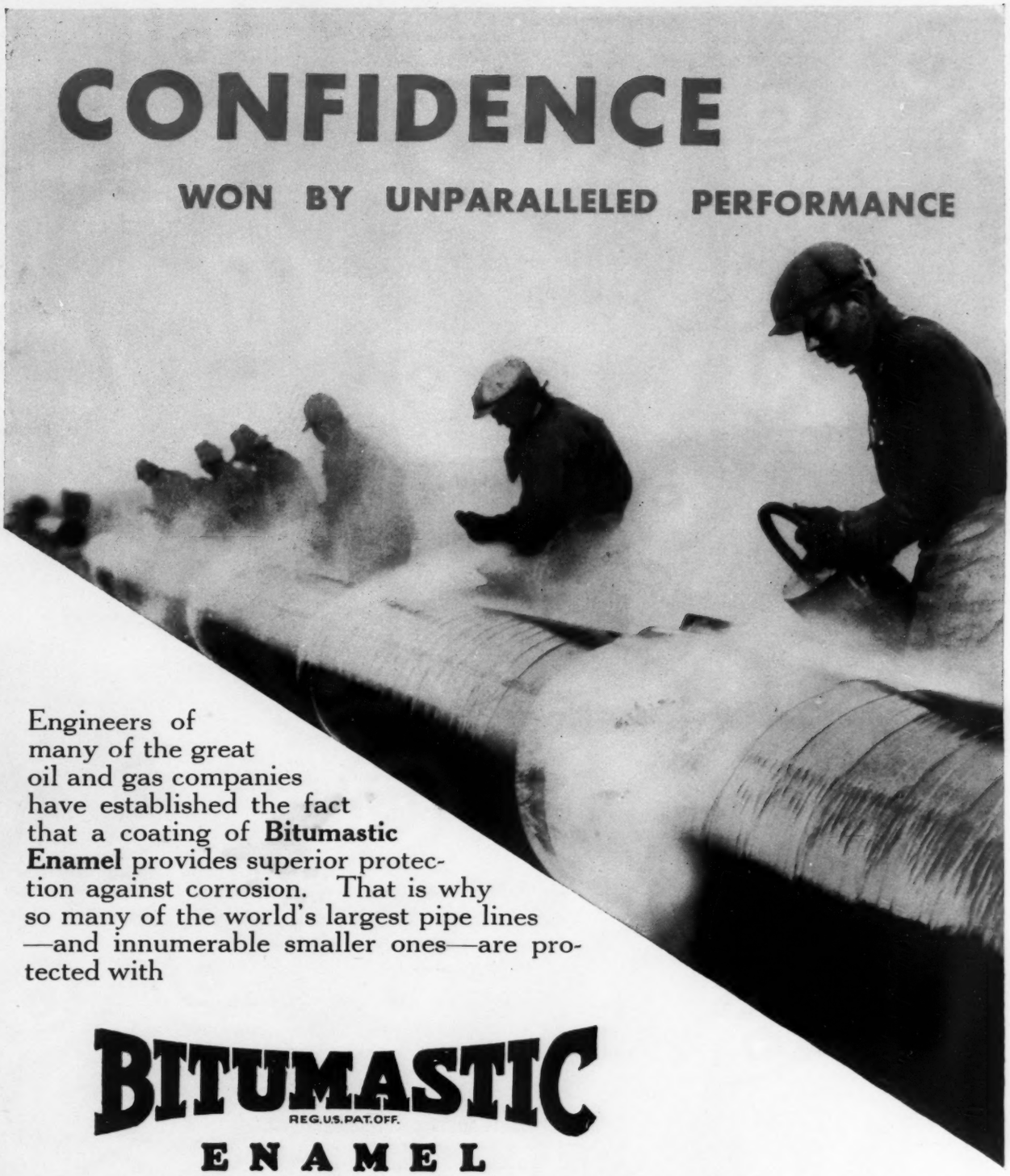

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